	Type	Hits	Search Text	DBs
1	BRS	1	"972579"	US-PGPUB
2	BRS	35	proxy same havi	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB
3	BRS	2062	proxy same gateway	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB
4	BRS	6102	ieee adj "1394"	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB
5	BRS	2219	firewire	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB
6	BRS	7217	(ieee adj "1394") or firewire	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB
7	BRS	50	(proxy same gateway) and ((ieee adj "1394") or firewire)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB
8	BRS	15	(proxy same gateway) same ((ieee adj "1394") or firewire)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB
9	BRS	37	proxy adj element	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB
10	BRS	397	proxy same bridge	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB
11	BRS	157	proxy near4 bridge	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB

	Type	L #	Hits	Search Text	DBs	Time Stamp
1	BRS	L1	7217	(ieee adj "1394") or firewire	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/02 12:41
2	BRS	L2	157	proxy near4 bridge	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/02 12:41
3	BRS	L3	12	1 and 2	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2004/04/02 12:41

US005754548A

United States Patent [19]

Hoekstra et al.

[11] Patent Number: 5,754,548

[45] Date of Patent: May 19, 1998

[54] **INTERCONNECTION OF LOCAL COMMUNICATION BUS SYSTEM**

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[73] Assignee: **U.S. Philips Corporation**, New York, N.Y.

[21] Appl. No.: **803,646**

[22] Filed: **Feb. 21, 1997**

Related U.S. Application Data

[63] Continuation of Ser. No. 394,977, Feb. 27, 1995, abandoned.

[30] **Foreign Application Priority Data**

Mar. 31, 1994 [GB] United Kingdom 9406477

[51] **Int. Cl.**[6] **H04L 12/66**; H04B 1/20

[52] **U.S. Cl.** **370/402**; 370/465; 395/309

[58] **Field of Search** 370/401, 402, 370/419, 420, 421, 464, 465, 466; 340/825.05, 825.54; 395/309, 200.14, 200.15, 200.02; 364/240.8, 240.9, 242.94, 940.81, 937

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,872,162	10/1989	Tanaka et al.	370/402
5,088,032	2/1992	Bosack	370/401
5,117,430	5/1992	Berglund	370/408
5,237,566	8/1993	Brand et al.	370/426
5,283,571	2/1994	Yang et al.	370/245
5,323,388	6/1994	Chang et al.	370/353
5,371,852	12/1994	Attanasio et al.	370/401
5,412,656	5/1995	Brand et al.	370/428
5,440,698	8/1995	Sindhu et al.	370/462
5,473,575	12/1995	Farnwald et al.	365/190
5,490,152	2/1996	Gregg et al.	370/471
5,513,327	4/1996	Farnwald et al.	395/309

OTHER PUBLICATIONS

International Standard. IEC 1030. First Edition 1991. pp. 49–53.

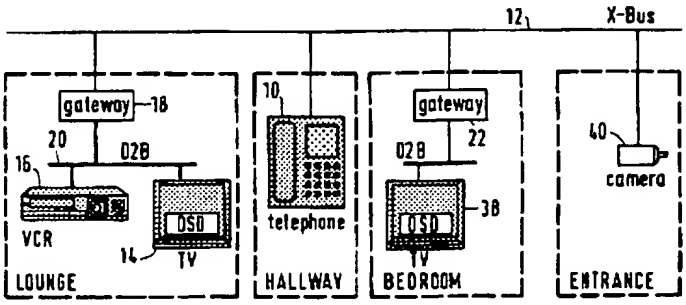
IEEE Transactions on Consumer Electronics vol. 36. No. 3. Aug. 1990 C. Ciocan. The Domestic Digital Bus System—A Maximum of Control Convenience in Audio Video pp. 619–622.

Primary Examiner—Benedict V. Safourek
Assistant Examiner—Seema S. Rao
Attorney, Agent, or Firm—Anne E. Barschall

[57] **ABSTRACT**

In a local communication system comprising a number of devices (**14.16**) interconnected by a first data bus (**20**) supporting a first set of communication protocols, and at least one further device (**10**) connected to a second bus (**12**) not supporting those protocols, a gateway device (**18**) is provided linking the first and second data buses enabling communications therebetween. The first set of protocols specifies a maximum time for response by a first device to a request sent by a second device. When a request is sent from a device (**14**) on the first bus to the further device (**10**), the gateway (**18**) times the request and, if no response is received from the further device within the specified maximum response time, the gateway (**18**) generates and sends a temporary response to the requesting device (**14**). The system may comprise two or more clusters of devices, each being linked to the further bus (**12**) by respective gateway devices (**18.22**).

19 Claims, 6 Drawing Sheets



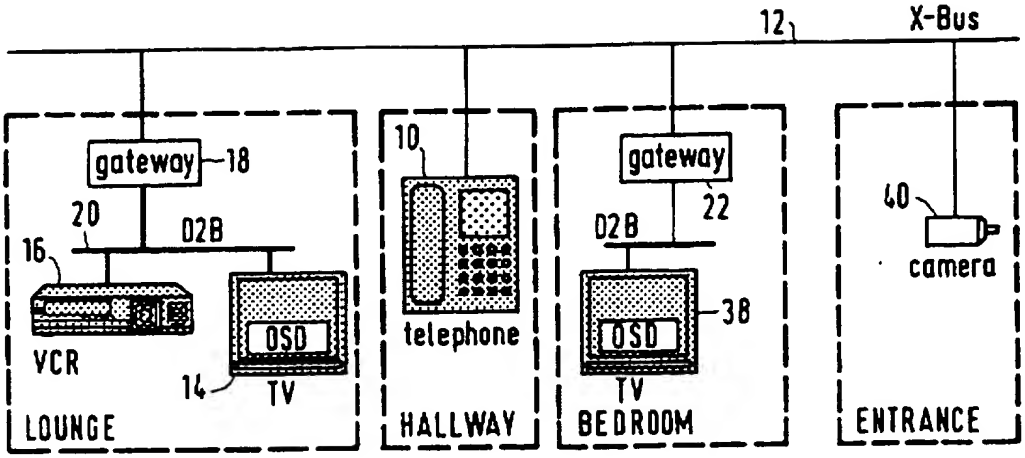


FIG.1

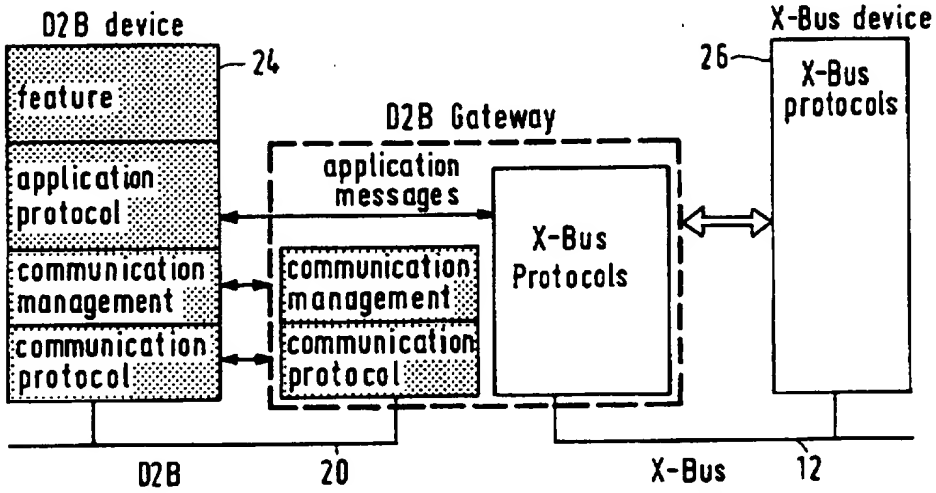


FIG.2

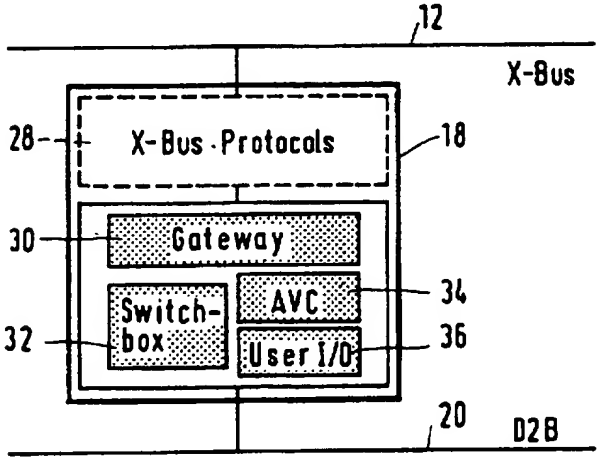


FIG.3

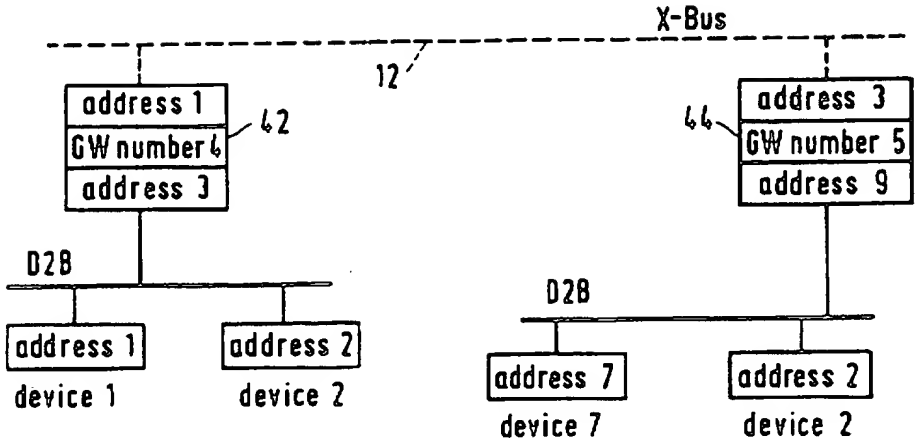


FIG.4

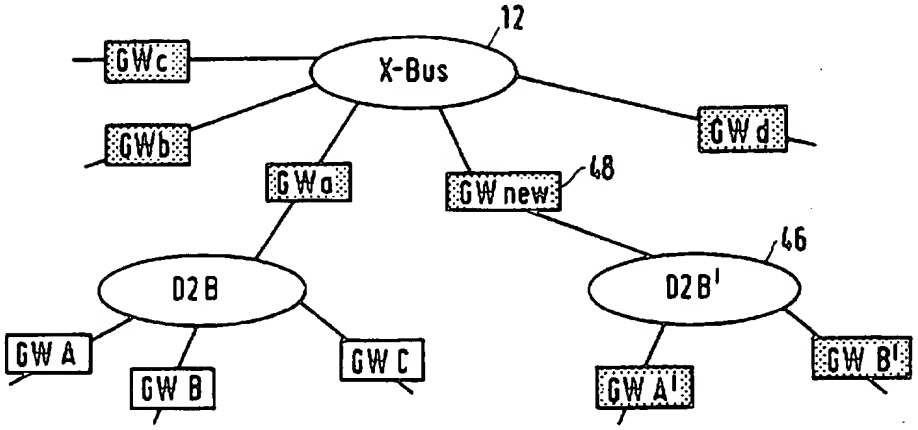


FIG.5

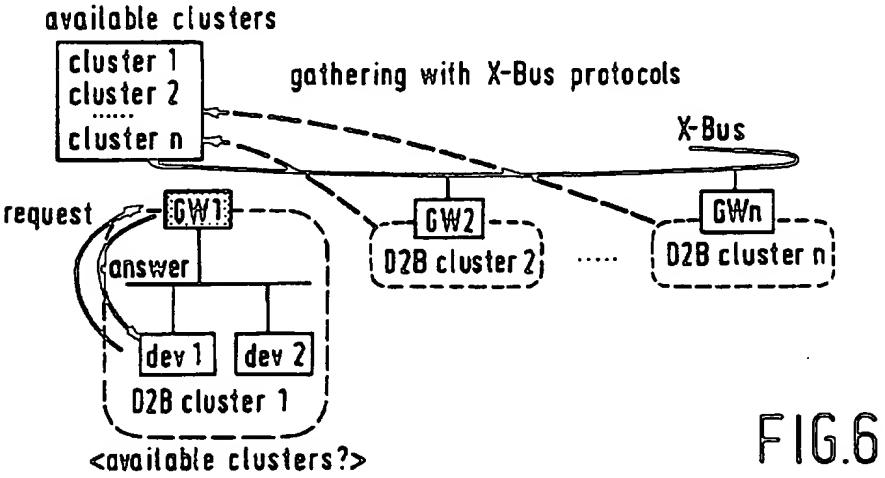


FIG.6

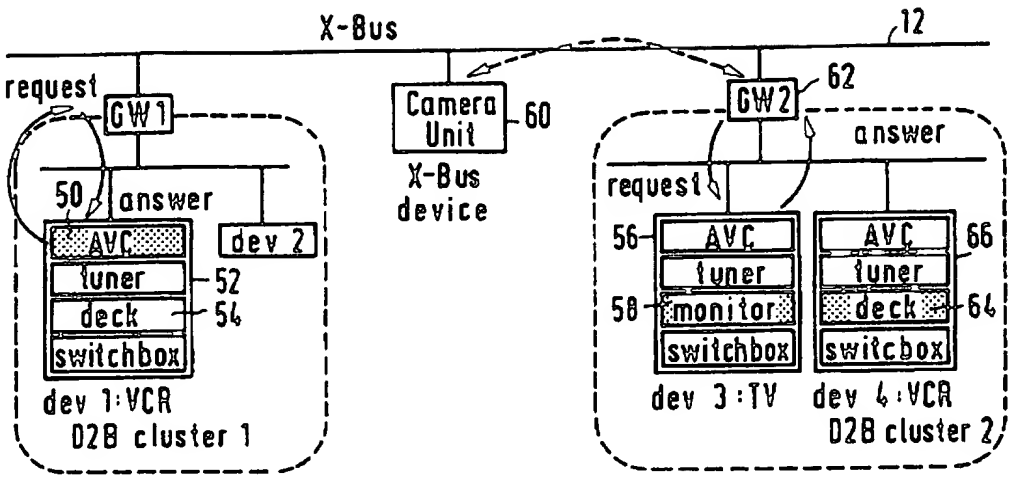

X-Bus
12
request
GW1
50
answer
AVC
tuner
deck
switchbox
52
54
dev 2
dev 1:VCR
D2B cluster 1
Camera Unit
60
X-Bus device
GW2
62
answer
request
56
AVC
tuner
monitor
switchbox
58
AVC
tuner
deck
switchbox
66
64
dev 3:TV
dev 4:VCR
D2B cluster 2

FIG.7

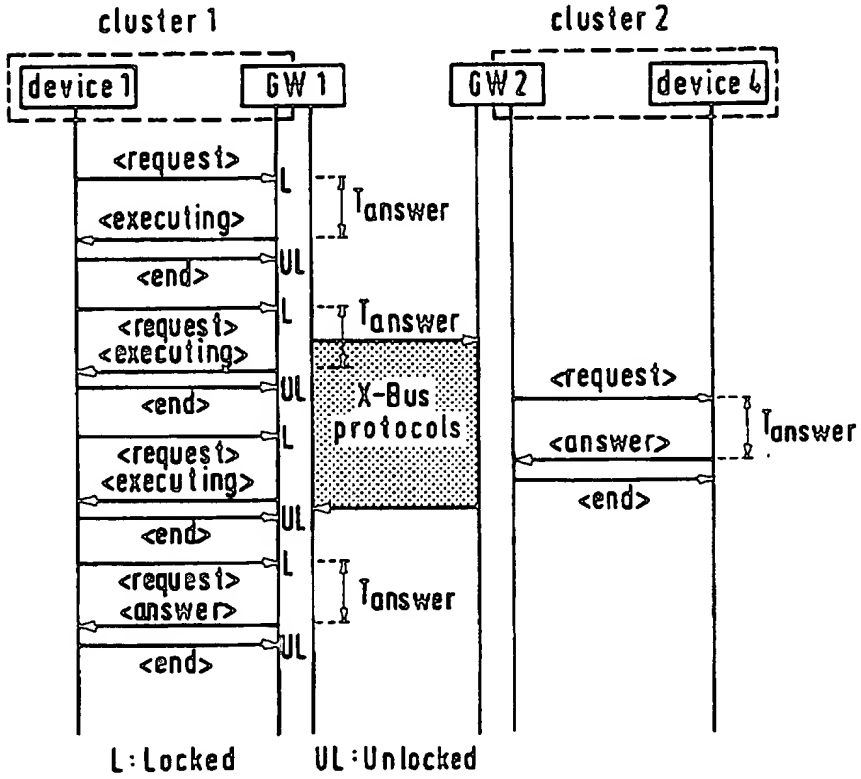

cluster 1
cluster 2
device 1
GW 1
GW 2
device 4
<request>
<executing>
<end>
<request>
<executing>
<end>
<request>
<executing>
<end>
<request>
<answer>
<end>
L
UL
Tanswer
X-Bus protocols
<request>
<answer>
<end>
L:Locked
UL:Unlocked

FIG.8

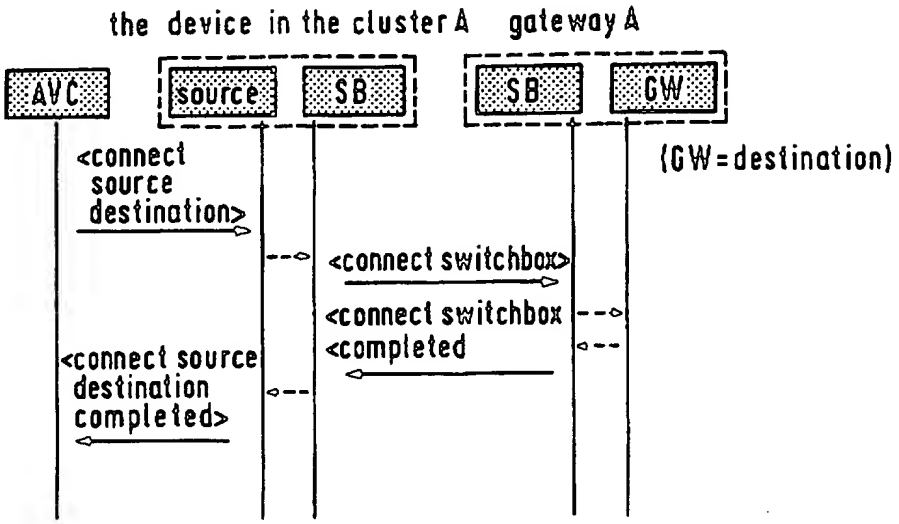

the device in the cluster A
gateway A
AVC
source
SB
SB
GW
(GW=destination)
<connect source destination>
<connect switchbox>
<connect switchbox completed>
<connect source destination completed>

FIG.9

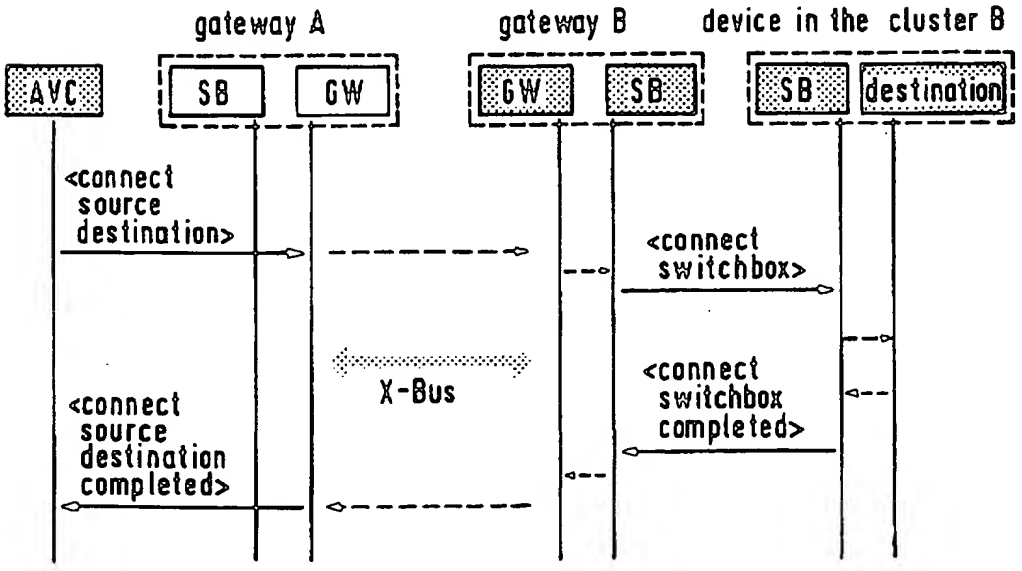

gateway A
gateway B
device in the cluster B
AVC
SB
GW
GW
SB
SB
destination
<connect source destination>
<connect switchbox>
X-Bus
<connect switchbox completed>
<connect source destination completed>

FIG.10

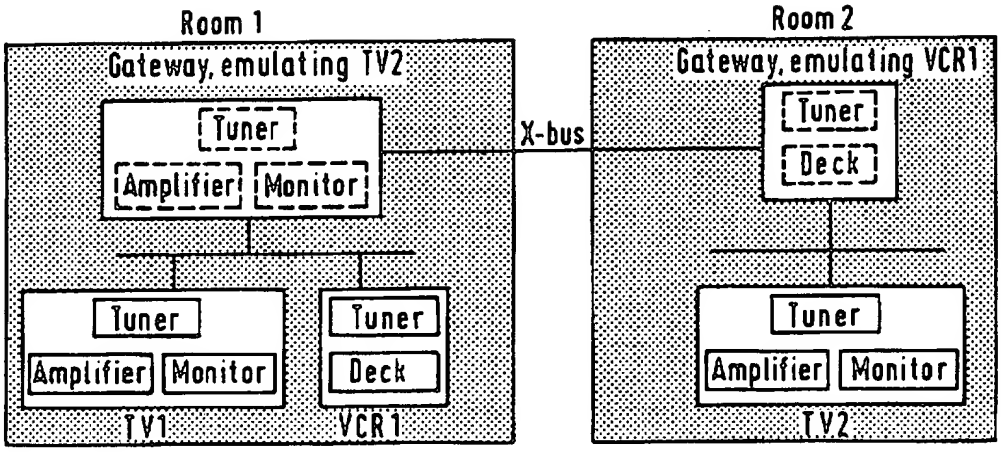


FIG.11

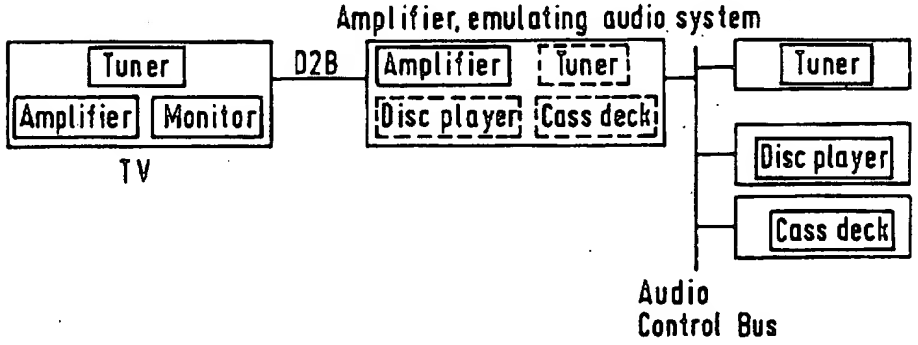


FIG.12

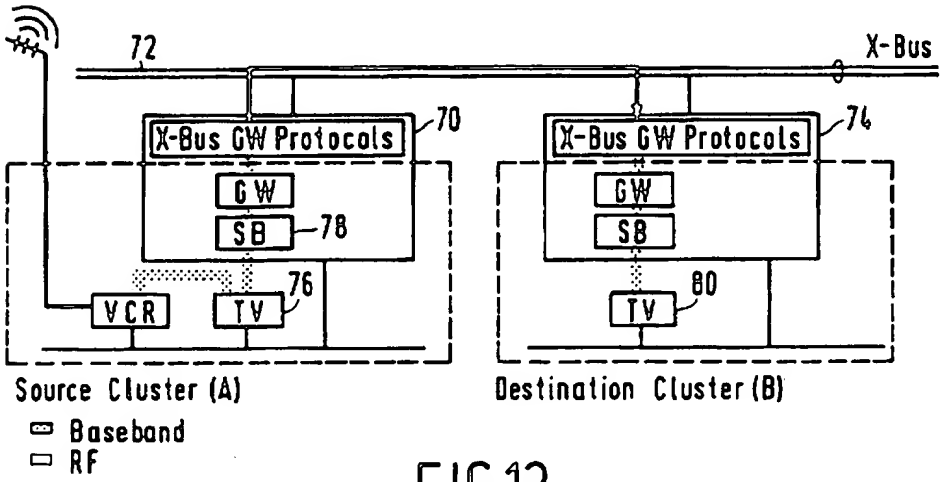


FIG.13

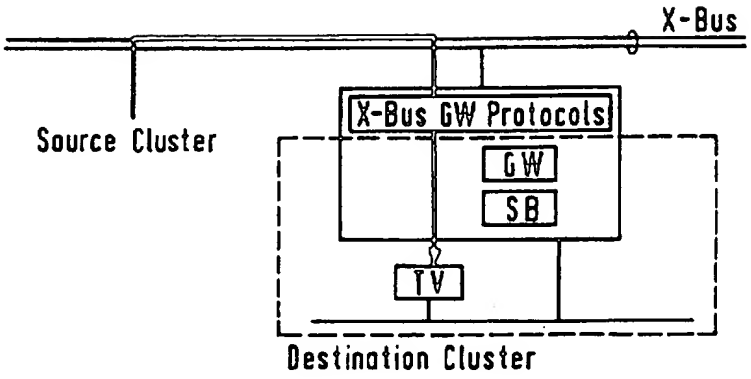

X-Bus
Source Cluster
X-Bus GW Protocols
GW
SB
TV
Destination Cluster

FIG.14

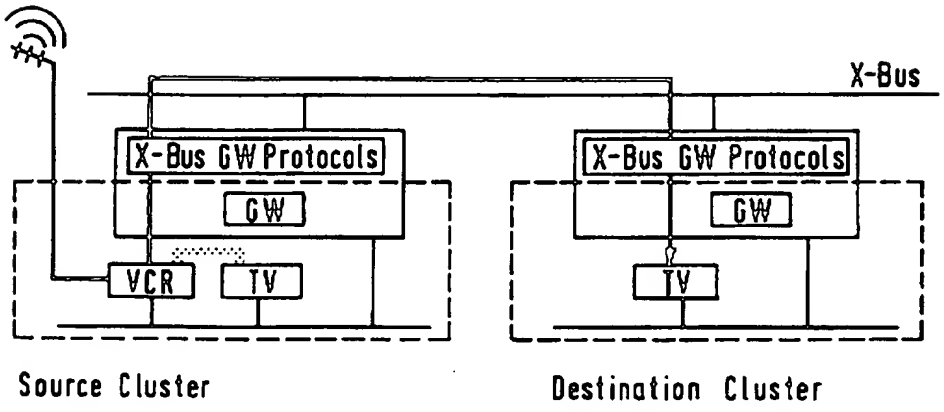

X-Bus
X-Bus GW Protocols
GW
VCR
TV
X-Bus GW Protocols
GW
TV
Source Cluster
Destination Cluster

FIG.15

INTERCONNECTION OF LOCAL COMMUNICATION BUS SYSTEM

This is a continuation of application Ser. No. 08/394,977, filed Feb. 27, 1995 now abandoned.

The present invention relates to a local communication system comprising a plurality of stations interconnected for the communication of messages via a first data bus and in accordance with a first set of communication protocols, at least one further station not supporting the said protocols, and a gateway device linking the first data bus and further station and operable to enable communications therebetween. The invention further relates to apparatus for use with such a system.

One known set of communications protocols is the Domestic Digital Bus (D2B) Standard, standardised by the International Electrotechnical Commission, Geneva, Switzerland, and issued under reference IEC 1030. D2B consists of a package of communication protocol specifications and system requirements, defining the way in which consumer electronics products can access and control each others functions via the Domestic Digital Bus. D2B is a general purpose control bus which also supports the transfer of limited amounts of digital data. Currently the main application area is Audio/Video (AV) equipment.

With all such domestic equipment interconnection schemes, there is a problem of connection to apparatus not supporting the communications protocols of the scheme. As an example, a user may have a music system comprising interconnected units such as a compact disc (CD) player, amplifier, tuner and cassette player which communicate with each other using a first set of communications protocols, together with an audio visual system comprising for example a television, video recorder and satellite receiver which communicate using a second set of protocols. In the absence of a certain degree of compatibility with existing systems, a user be faced with having to replace many items at one time. One way to reduce this problem is to provide a gateway device which supports two or more sets of communications protocols and can "translate" messages between them.

A D2B can be used as a subsystem within a home electronic bus (HEB) system, and the IEC Standard 1030 specifies in Section 11 thereof certain minimum requirements for a gateway device linking the D2B to the HEB. A problem which occurs with gateway devices, relates to the timing of messages and in particular the time within which any device requesting information from another may expect to receive a response. When a first device receives a request from another device connected to its own local bus system, it should make an answer available as quickly as possible: a maximum response time may be specified such that no device becomes "jammed" whilst waiting for a response from a device which for some reason is unable to answer. However, in the present situation of gateway communication, such as from one D2B cluster to another via an intermediate bus system not supporting D2B protocols, an inevitable and unpredictable delay may occur due to the delay of transmission via the intermediate bus.

In accordance with the present invention there is provided a local communications system of the type set forth in the opening paragraph wherein the first set of communications protocols specifies a maximum time for reply by a first station to a message sent by a second station, and wherein when a message requiring a response is passed between a station of the first bus system and the said further station via the gateway device, the gateway device is configured to

generate and send a temporary response to the message originating station, within a predetermined period less than the specified maximum response time, pending arrival of a response from the station receiving the message, and subsequently passes the said response on its arrival. Preferably, the gateway device includes memory means within which a record of a message passed is stored.

Following the sending of a temporary response to a first requesting station, the gateway device is preferably operable to pass messages from other requesting devices, with the memory means maintaining a record of the first message.

The gateway device may support requests from stations connected to the first data bus for information regarding the identity of further gateway devices beyond the gateway and be operable to pass messages to further stations via such further gateway devices, including messages verifying or detecting the presence of stations beyond further gateways.

Additionally, the gateway device may be operable to emulate, to each station connected to the first data bus and in accordance with the first set of communications protocols, the behaviour of the or each further station linked to the first bus through the gateway device.

Where the system comprises two or more clusters of stations, each cluster comprising a plurality of stations interconnected by a respective data bus and communicating within the cluster in accordance with respective sets of communications protocols, the clusters may be linked to each other by a further communications bus supporting a further set of communications protocols, with each being linked to the further bus by a respective gateway device.

By providing a temporary response, the gateway device handles any inconsistencies of timing with the temporary response meeting the requirements for a response to be received within a maximum period.

Further features and advantages of the present invention will be apparent from reading of the claims and the following description of preferred embodiments of the present invention, now described by way of example only and with reference to the accompanying drawings in which:

FIG. 1 schematically represents a domestic audio/visual application using a number of interconnection buses;

FIGS. 2 and 3 are block schematic representations of a gateway device linking two data buses;

FIG. 4 illustrates linking of two local data network clusters;

FIG. 5 illustrates gateway numbering in a multiple cluster network system;

FIG. 6 schematically illustrates the determination by a first gateway device of numbers of other gateway devices;

FIG. 7 represents the determination by a device connected to a first gateway of the configuration of a device connected to a second gateway;

FIG. 8 is a timing diagram illustrating gateway timing management;

FIGS. 9 and 10 are timing diagrams for signal path building in source and destination clusters;

FIGS. 11 and 12 represent emulation by a gateway; and

FIGS. 13 to 15 represent methods for RF and baseband signal handling in cluster interconnection.

The following description will cover the enabling by a gateway device embodying the present invention of access by devices on a first bus system (referred to hereinafter as an X-bus) to the functions available within a D2B system and vice versa, via the gateway device.

An example of such an application, as shown in FIG. 1, comprises a telephone 10, attached to an X-bus 12 and using the on-screen display (OSD) function of a television 14

within a D2B cluster (of which television 14, a VCR 16 and gateway 18 connected via D2B 20 are shown). The telephone 10 could use the OSD function to display a message, perhaps to announce that there is a call and give details of the caller. Alternatively, the telephone 10 may be used to program the VCR 16 of the D2B cluster from a remote location.

As also shown in FIG. 1, more than one D2B cluster may be connected via the X-bus 12 with each cluster being connected thereto via a respective gateway 18,22. Accordingly, the gateways 18,22 enable application messages to be sent not only between devices in a D2B cluster and devices on the X-bus, but also between devices in separate D2B clusters.

The gateway 18 provides a logical interface between the D2B and X-Bus which manages the transfer of messages from D2B to X-Bus transparently.

As shown in FIG. 2, the gateway 18 is in charge of the protocol interface between D2B and X-Bus, and its functionalities are concerned with the communication between D2B and X-Bus, with a message from a D2B device 24 translated into an X-Bus message by the X-Bus protocol of the gateway, and transferred to an X-Bus device 26. Where the X-Bus device is a further D2B cluster (as in FIG. 1), the X-Bus message is translated into D2B protocol by the gateway 22 connecting the further cluster to the X-Bus 12.

FIG. 3 shows the D2B side of the gateway device 18, with a gateway subdevice 30 providing an interface to the X-Bus protocols 28 and in charge of the basic role of executing transparent message communication with a device outside of the cluster. The gateway subdevice 30 is necessary to permit basic applications such as controlling simple devices via the D2B gateway. For more complex applications, the device containing the gateway 30 may include other subdevices such as a switchbox subdevice 32 to make signal connections to and from a D2B cluster for audio/video signal distribution. For other applications such as central control from the gateway, an AVC subdevice 34 and a user I/O subdevice 36 may be required within the gateway device.

If the gateway is connected to more than one network, for example X-Bus A and X-Bus B, then the gateway subdevice 30 provides separate protocol interfaces for each network.

Referring again to FIG. 1, when a device or subdevice in one D2B cluster (in this case the television 38) wishes to send an application message to a device or subdevice in another D2B cluster (a playback command to VCR 16), the application on the source device assembles the gateway routing information together with commands and requests into an application message which is placed in a D2B message. The devices' communication facilities send the D2B message to the gateway 22 within its own cluster. The gateway routing information in the D2B message contains a gateway number which identifies the gateway 18 of a D2B cluster to which the message should be sent.

The first cluster gateway 22 uses this gateway number to pass the contents of the message, via the connecting X-Bus 12 to the gateway 18 of the destination cluster. When the message reaches the gateway 18 of the receiving cluster, the gateway 18 replaces its own number in the routing information with that of the gateway 22 of the originating cluster such that the device or subdevice receiving the message can identify its originating cluster. The receiving gateway 18 then uses the altered application message to generate a new message conforming to D2B protocols for passage via D2B 20 to its destination device or subdevice.

When a device or subdevice in one D2B cluster wishes to send an application message to a device on the X-Bus (which device supports messages from the D2B cluster device), such as television 14 sending control commands to security camera 40, television 14 assembles the gateway routing information together with commands and requests into an application message, which is placed in a D2B message. In this instance, the gateway routing information contains the gateway number of the gateway 18 within the originating cluster. The televisions network communication facilities send the D2B message to the identified cluster gateway 18 for transmission over the X-Bus to the camera 40.

When a device on the X-Bus wishes to send a message to a device in a D2B cluster, the message is sent via X-Bus to a gateway 18 for that cluster where a D2B message identifying the receiving gateway is assembled and then passed over the D2B to the destination device e.g. VCR 16.

On each bus, each device has an address. Gateway devices therefore have two addresses, one for each bus to which they are attached. In the example shown in FIG. 4, two gateway devices 42,44 for respective D2B clusters are connected to X-Bus 12. It will be understood that in this example, any relationship between the gateway number, D2B address and X-Bus address is strictly coincidental.

Suitably a limit of 8 gateway devices connected to a single D2B bus system is imposed, with the D2B addresses for the gateways as follows:

TABLE 1

bit 11	...	bit 0	bit 11	...	bit 0
0000	10110	000('0B0'H)	0000	11110	000('0F0'H)
0000	10110	001('0B1'H)	0000	11110	001('0F1'H)
0000	10111	000('0B8'H)	0000	11111	000('0F8'H)
0000	10111	001('0B9'H)	0000	11111	001('0F9'H)

The address of the D2B gateway device is specified in the Communication Telephony (CT) service type area (service type specified as '0000'H).

A further limit, of only one gateway subdevice within a device on D2B, is imposed. The gateway subdevice address is allocated in the CT service area and specified as '0B0'H—as the first entry in Table 1 above.

For a D2B device, only one address is allowed. The device address of the gateway is determined by the main functionality of the device, which is implementor defined. If the gateway is a stand-alone gateway (that is to say not as a subdevice of a D2B AV device), one of the eight gateway addresses is allocated to it. When a gateway is implemented as one of the subdevices in an AV device, the device may be defined with an AV device address. If the gateway subdevice is implemented in for example a television set with other subdevices such as a monitor subdevice, a tuner subdevice, a switchbox subdevice and others, the device containing the gateway subdevice will be identified by the video monitor subdevice, which is the main function of that device. If a gateway subdevice is implemented in an X-Bus device such as a room controller or telephone, for controlling D2B devices with D2B protocols, an AVC subdevice is necessary, even though the X-Bus device has no particular AV function. In this case, an AVC device address is allocated to the X-Bus device.

Each gateway subdevice is allocated a 4-bit encoded gateway number. In a system which consists of a D2B cluster and an X-Bus connected via a gateway, a maximum of 16 gateways are permitted. Every gateway either knows or can determine all the gateways which are connected to either of the busses it connects. The gateway number is used

by a gateway subdevice to logically identify the known gateways. It is used when a message is going to be sent from one network to another via a gateway. Each gateway needs to number its known gateways and store them.

In FIG. 5, a cluster 46 (D2B') is going to be connected to X-Bus 12 via gateway 48 (GWnew). After connection to X-Bus, gateway GWnew needs to know its possible gateways on both X-Bus and cluster D2B', which are gateways GWa to GWd on X-Bus and GW_A, and GW_B, on D2B'.

For gateways on X-Bus, the X-Bus side of the gateway GWnew collects addresses of the gateways on X-Bus and informs the (D2B side) gateway subdevice of them. The X-Bus side of the gateway needs to have a table of the allocated gateway numbers and the X-Bus address of each gateway wherein GWnew and GWa to GWd (all X-Bus addresses) are respectively numbered 1 to 5. For gateways on D2B', the gateway subdevice in GWnew investigates whether there is/are any other gateway(s) on D2B' and, if there are any, it stores the address of the/each such gateway. In the present example, D2B' addresses GW_A and GW_B are stored in the table as numbers 6 and 7 respectively.

When a message is going to be transferred from a device in D2B' to X-Bus via GWnew, the gateway translates the gateway number to the corresponding X-Bus address and transfers the received message to it. When a message is sent from X-Bus and is going to be transferred to D2B', the gateway subdevice in GWnew translates the gateway number to the corresponding D2B address and transfers the received message to the device.

In the same way, GWa may have its own possible gateway numbers independently from any other gateway numbers such that, for GWa the table gives GWa to GWd and GWnew (all X-Bus addresses) as 1 to 5 respectively and GW_A to GW_C (all D2B addresses) as 6 to 8 respectively.

The basic functions of the gateway subdevices are to execute the routing command and set up the routing of the messages to the network beyond the gateway, and to receive a message from the network beyond the gateway and send it the D2B device with a routing command which specifies the routing information.

The details of the routing command will be described in greater detail hereinafter. In order to execute these functions, in addition, the gateway must also have the following (necessary for gateway communication):

- Cluster management to provide the device with the capability to get necessary information for communication with a device outside of its cluster;
- Timing management to guarantee proper communication timing within a D2B cluster according to D2B communication management protocols.

In remote AV applications, it may be needed to distribute signals via a gateway. In order to make it possible to transmit an AV signal from one cluster to another cluster or between the D2B and the X-Bus, the D2B gateway may optionally have:

- A signal distribution function executed by a gateway subdevice acting as an AV source or destination and a switchbox subdevice to make signal connections in the D2B cluster(s).

In the following paragraphs, these functions of cluster management, timing management and signal distribution functions are described in greater detail.

Cluster Management

Within the D2B cluster each device is able to read property memories of other devices. For example a VCR is able to send requests to other devices to find out which one can display a picture. In the same way, the configuration of a cluster can be gathered by the gateway.

For an application using the devices in different D2B clusters, a device in one cluster may need to know whether the requested functionality is available in other clusters and to which device in the other cluster it should send a message. To obtain this information, the interested device may ask with a request message from one cluster to another via a gateway. In order to communicate via a gateway, the device needs to know the gateway numbers, the addresses of devices in the remote cluster and the addresses of the subdevices in each remote device, to be used in the routing command.

For a device which is going to communicate with a device in a remote cluster, it is necessary to know which other D2B clusters are available. Each gateway on X-Bus needs to get and store this information before gateway communication is required. How to gather this information is implementor defined and based on the X-Bus protocols, and the interested device can ask the gateway to send this information with an "available clusters?" request. The gateway which receives the request returns the gateway numbers of the available gateways belonging to the X-Bus, as shown for gateway GW1 in FIG. 6.

In D2B a device can discover the configuration of other devices conforming to the protocol and connected to the bus. The configuration (i.e. the number of subdevices and the address of each) may be determined by an interested device sending a <number of subdevice?> request. Similarly, a device in a first D2B cluster can discover the configuration of a device in a second D2B cluster by sending the request via X-Bus.

FIG. 7 illustrates the obtaining of remote cluster and device configuration info in an example system. Supposing that the AVC subdevice of VCR 52 in the D2B cluster 1 wants to know the device which can display the video signal of the deck subdevice 54 in the D2B cluster 2. Firstly, the AVC 50 tries to find the TV 56 in the remote cluster. The AVC 50 sends the request to the remote cluster with a routing command followed by the monitor device as a destination address. The TV 56 with a monitor device address in the remote cluster answers for this request by sending the number of its subdevices and the address of each of them. Then the AVC subdevice in the local cluster can know the necessary address information of which it should communicate for its application (in this case the monitor subdevice 58).

For the communication from a device on X-Bus, such as camera unit 60 (FIG. 7), to a device in the D2B cluster, the X-Bus device needs to know to whom it should send a message. Supposing that the camera unit 60 on the X-Bus 12 wants to send a video signal to the D2B device which can display the picture of the video signal on the display facility: in effect the camera wishes to know whether there is a TV in the D2B cluster. Firstly, the camera 60 sends a message to request device configuration with a monitor device address as a destination address. In this sequence, communication between the camera 60 and the X-Bus side gateway subdevice of the gateway device 62 of the cluster is executed with the X-Bus protocols. The X-Bus side gateway translates a received X-Bus format message into the appropriate D2B message (the <number of subdevices?> request), and passes it to the D2B side gateway subdevice of gateway 62. The gateway subdevice sends the request to the monitor subdevice 58 following a routing command and its operand. If an answer is obtained properly from the D2B device, the gateway subdevice passes it to the X-Bus side gateway subdevice which then transfers it to the camera unit 60 using the X-Bus communications protocols.

In addition, if the camera unit **60** wants to send its video signal to the device which has a recording facility, it can investigate whether there is a device with such a facility in the D2B cluster in the same way by sending a message to request device configuration with the address of a deck device as a destination address. In this instance the address for the deck subdevice **64** of VCR **66** will be returned.

If a device in the D2B cluster wants to know the configuration of a device on the X-Bus, it is obtained in the same way with requests being translated between protocols at the gateway.

Timing Management:

When a subdevice receives a request, it should make an answer available as quickly as possible. However, in the present situation of gateway communication, such as from one D2B cluster to another, an inevitable and unpredictable delay may occur due to the delay of transmission via the X-Bus. The timing management by the gateway subdevice is executed by providing a temporary answer to the device which has sent the request to a device within another cluster.

Referring again to FIG. **7** and also to the timing diagram of FIG. **8**, it is assumed that device **1** in cluster **1** wants to get property info from device **4** in cluster **2** using a request and answer. In this situation the procedure is as follows. Firstly, device **1** sends a request to gateway GW1 with a routing command. Until GW1 obtains the final answer (for example the message "executing") from device **4** in cluster **2**, GW1 returns a temporary answer for the request from device **1** within a specified minimum response time. Note that, in order to prevent occupation of the gateway subdevice (slave) by a particular master during a request sequence, the device sending a request needs to unlock the gateway by issuing an <end> command after receiving a temporary answer from the gateway. Before the next request from device **1** is received, the gateway subdevice may receive a message to be transferred beyond the cluster from another D2B device (e.g. device **2**). Even in such a case, the gateway subdevices must keep the ongoing request sequence by device **1**.

The second stage of the procedure is the transfer of the request from GW1 to GW2. This procedure must be executed by means of communications between the gateways according to X-Bus protocols and D2B routing protocols. Thirdly, GW2 sends a request to device **4** which is repeated until a final answer is obtained. The fourth stage is the return by device **4** of the answer (which may be the final answer). The fifth stage is the transfer by GW2 of the obtained answer with the final value to GW1, and the storage by GW1 of the final answer: again, this is executed by means of communication between the devices according to X-Bus protocols. The final stage is the return of the answer with the final value from GW1 to device **1**.

Signal Distribution:

As previously mentioned, the signal distribution functionality is optional, although it will be recognised that it is required for an application using av signals via D2B and an X-Bus which can carry av signals. It will also be recognised that, for signal distribution functionality, both the signal connection in AV clusters and signal presentation to X-Bus are required. In the following paragraphs, it is assumed that the X-Bus has AV signal capability.

Within a D2B cluster, the signal connection is made by the AVC subdevice at baseband from a 'source' to 'destination', possibly via one or more switchboxes. If a signal has to be transferred via X-Bus, the local destination will be the gateway. Between different D2B clusters, the related commands and requests are transferred with the routing command: actual switching on the X-Bus has to be done according to X-Bus protocols.

The basic procedures for connection in both source and destination clusters will now be described with reference to FIGS. **9** and **10** which are timing diagrams for signal path building in the source cluster (FIG. **9**) and in the source cluster and destination cluster (FIG. **10**).

In the connection procedure for a source cluster, the subdevice address of the gateway subdevice is specified as a <destination> in the <connect source destination> command, a <connect switchbox> command, a <connect switchbox completed> command, and a <connect source destination completed> command. After completion of the signal path both in the source cluster and in the destination cluster, the gateway with X-Bus may start switching and building signal path connection on the X-Bus.

If a connection is going to be made to a remote cluster (destination cluster), the connection in the destination cluster is made from the gateway subdevice to the destination subdevice (e.g. a monitor subdevice) in the destination cluster by the AVC subdevice as that which has made a source signal connection. In this case the remote gateway subdevice acts as a source subdevice in the destination cluster. The connection in the destination cluster can be made independently from the connection in the source cluster. The AVC subdevice in the source cluster sends a <connect source destination> command to the gateway subdevice in the destination cluster to establish a connection in the destination cluster. The commands <connect source destination> and <connect source destination completed> are transparently transferred from one cluster to another with the routing command. After the connections both in the source cluster and in the destination cluster are established, the signal can be transferred from the source subdevice in the local cluster to the destination subdevice in the remote cluster.

The gateway device is operable to emulate, to each station connected to the first data bus and in accordance with its local set of communications protocols, the behaviour of the or each further station linked to the first bus through the gateway device. FIG. **11** shows a pair of such an "emulating gateways" with the gateway in Room **1** emulating the television in Room **2**, and the gateway in Room **2** emulating the VCR in Room **1**. In an extension to this system, where a number of devices are connected together in a cluster supporting a first protocol (in this instance Audio control) one of the devices may act as an emulating gateway imitating the AV system as a whole to the television on the D2B bus, as shown in FIG. **12**.

Signal presentation depends on the X-Bus protocols and also depends on the applied signal allocation mechanism for the X-Bus, e.g. static-allocation, dynamic-allocation an so on. This means that the signal presentation functionality is necessary for a feature requiring signal distribution but the actual signal switching must be carried out using the X-Bus protocols. The following description refers only to D2B protocols.

In the signal distribution of the destination cluster, the actual procedure including signal connections depends on the type of signal distribution system, and/or whether the destination gateway subdevice has capability to convert the signals from the X-Bus into the baseband signals which can be managed by the D2B protocols, and they are implementor defined.

Three types of signal distribution systems will now be discussed with reference to FIGS. **13** to **15** in which RF signal connections are shown as broad dark lines and baseband paths as broad lighter-coloured lines.

The first type comprises two clusters each supporting the same set of communications protocols and linked by a data bus supporting a further set of communications protocols. A signal path is established between a station of the first cluster and a station of the second cluster as baseband signal paths between each station and its local gateway and as a further signal path between the gateways and selected by one of the gateways from those available within the communications structure supported by the linking data bus. In this first type of distribution system, signal connections in the local cluster (source cluster) and the remote cluster (destination cluster) must be made by the AVC subdevice which is executing an application. The connection procedure both in the source and destination clusters must be done based on the existing D2B connection and protection protocols.

For the signal interchange between an X-Bus and a D2B cluster or vice versa, the signal must be presented by the gateway subdevice. For the signal presentation in the example shown in FIG. **13**, the gateway subdevice **70** in the source cluster A plays the role of modulator from baseband to (one of) the frequencies which is applied on the X-Bus signal line. If more than one frequency (or channel) is available, some procedure for selecting one of them may be necessary before signal transmission to the X-Bus **72**. On the other hand, the gateway subdevice **74** in the destination cluster acts as a demodulator from X-Bus format (RF) to baseband. An AV signal from the monitor subdevice of TV **76** in cluster A is switched to a switchbox **78** in the gateway **70** and then modulated onto a coaxial cable or an optical fibre. In the remote cluster B, the modulated signal (RF) is put into the gateway **74** and demodulated to the baseband signal, and led to a monitor subdevice (the destination subdevice) in TV **80**.

The second type of the system comprises two clusters each supporting the same set of communications protocols and linked by a data bus supporting a further set of communications protocols. A signal path is established between a station of the first cluster and a station of the second cluster as a baseband signal path from a first one of the stations to its local gateway, as a further signal path between the gateways and selected by one of the gateways from those available within the communications structure supported by the linking data bus, and as a Radio Frequency signal path from the other of the stations to its other gateway. This second type applies an aerial type input in the destination cluster, in which system the AV signals are directly led fro X-Bus to destination. The signal connections in the source cluster are made by the executing AVC subdevice as shown in FIG. **9**, and the signal connections in the destination cluster are made by alternative means, e.g. manually, such that D2B connection procedures are not necessary. The gateway subdevice in the destination cluster does not need a signal conversion (demodulation) capability, which is dune by the tuner subdevice in the destination device, e.g. a TV.

In the example shown in FIG. **14**, depending on the frequency (or channel) used for modulation, the destination must be tuned to the appropriate frequency before transmission which may be accomplished by the AVC in the local cluster sending a <frequency> or <channel> command to the tuner subdevice in the remote cluster. If a dynamically-allocated frequency is used for the signal on the X-Bus, the gateway subdevice needs to know the possible frequency on the X-Bus for modulation of the AV signal. In such case, the procedure for detecting a possible frequency on the X-Bus depends on the X-Bus protocols and is implementor defined.

The third type of the system comprises two clusters each supporting the same set of communications protocols and linked by a data bus supporting a further set of communications protocols. A signal path is established between a station of the first cluster and a station of the second cluster as radio frequency signal paths between each station and its local gateway and as a further signal path selected by one of the gateways from those available within the communications structure supported by the linking data bus. This third type of system is the simple signal distribution system (as represented by FIG. **15**), and the gateway does not have a signal conversion capability. As the signal distribution within a D2B cluster is based on interconnections of baseband signals, in this type of system, signal connections need be made by another way (e.g. manually) and D2B connection procedures are not necessary. The gateway subdevices act only for transferring commands between clusters.

To avoid errors, the AVC subdevice which is responsible for the application using AV transfer via X-Bus must run the connection procedure in an appropriate manner according to the selected one of the above-mentioned three types of signal distributing system. Accordingly, the following rules are observed by an AVC subdevice making connections beyond its cluster and the gateway subdevice in the destination cluster. Firstly, if the gateway subdevice which does not have the demodulating function receives the connection command from the AVC subdevice in the source cluster, the gateway subdevice should not attempt to make connection in its cluster. Secondly, if the AVC subdevice in the source cluster does not receive a <connect source destination completed> command from the destination cluster, this means that the gateway subdevice in the destination cluster does not have a demodulating function and the signal connections in the destination cluster must be effected by some other means, e.g. manually.

From reading the present disclosure, other variations will be apparent to persons skilled in the art. Such variations may involve other features which are already known in the design, manufacture and use of local communication systems, home entertainment systems and component parts thereof and which may be used instead of or in addition to features already described herein. Although claims have been formulated in this application to particular combinations of features, it should be understood that the scope of the disclosure of the present application also includes any novel feature or any novel combination of features disclosed herein either implicitly or explicitly or any generalisation thereof, whether or not it relates to the same invention as presently claimed in any claim and whether or not it mitigates any or all of the same technical problems as does the present invention. The applicants hereby give notice that new claims may be formulated to such features and/or combinations of such features during the prosecution of the present application or of any further application derived therefrom.

We claim:

1. A local communication system comprising:

a plurality of stations interconnected for communicating messages via a first data bus and in accordance with a first set of communication protocols;

at least one further station not supporting said protocols; and

a gateway device linking the first data bus and the further station and operable to enable communications therebetween;

wherein

the first set of communications protocols specifies a maximum time for reply by a first station to a message sent by a second station, and

when a message requiring a response is originated by a station of the first bus system and passed to said further station via the gateway device, the gateway device is configured to (i) generate and send a temporary response to the originating station within a predetermined period less than the specified maximum response time, pending arrival of a response from said further station, (ii) during said pendency provide for passage of a message to or from another station of the first bus system, and (iii) upon arrival of said response from said further station, pass said response to the originating station.

2. A system as claimed in claim 1, wherein the gateway device includes memory means within which a record of at least one message passed thereby is stored.

3. A system as claimed in claim 2, wherein following the sending of said temporary response to the originating station, the gateway device is operable to pass messages from other requesting stations, with the memory means maintaining a record of the message requiring the response.

4. A system as claimed in claim 3, in which the gateway device supports requests from stations connected to the first data bus for information regarding the identity of further gateway devices beyond the gateway and is operable to pass messages to further stations via such further gateway devices, including messages verifying or detecting the presence of stations beyond further gateways.

5. A system as claimed in claim 2, in which the gateway device supports requests from stations connected to the first data bus for information regarding the identity of further gateway devices beyond the gateway and is operable to pass messages to further stations via such further gateway devices, including messages verifying or detecting the presence of stations beyond further gateways.

6. A system as claimed in claim 1, in which the gateway device supports requests from stations connected to the first data bus for information regarding the identity of further gateway devices beyond the gateway and is operable to pass messages to further stations via such further gateway devices, including messages verifying or detecting the presence of stations beyond further gateways.

7. A system as claimed in claim 1, in which the gateway device is operable to emulate, to each station connected to the first data bus and in accordance with the first set of communications protocols, the behaviour of the or each further station linked to the first bus through the gateway device.

8. A system as claimed in claim 1, wherein the plurality of stations are organized into at least first and second clusters, each cluster having a respective local gateway device and supporting the same set of communications protocols, the clusters being linked by a data bus supporting a further set of communications protocols, wherein a signal path is established between a station of the first cluster and a station of the second cluster as

baseband signal paths between each station and its local gateway device and

a further signal path between the gateway devices, the further signal path being selected by one of the gateway devices from those available within a communications structure supported by the linking data bus.

9. A system as claimed in claim 1, wherein the plurality of stations are organized into at least first and second clusters, each cluster having a local gateway device and supporting the same set of communications protocols, the clusters being linked by a data bus supporting a further set of communications protocols, wherein a signal path is established between a first station of the first cluster and a second station of the second cluster as

a baseband signal path from the first station to its local gateway device and

a further signal path between the gateway devices and which further signal path is selected by one of the gateways from those available within the communications structure supported by the linking data bus, and

a Radio Frequency signal path from the second station to its local gateway device.

10. A system as claimed in claim 1, wherein the plurality of stations are organized into at least first and second clusters, each cluster having a local gateway device supporting the same set of communications protocols, the clusters being linked by a data bus supporting a further set of communications protocols, wherein a signal path is established between a station of the first cluster and a station of the second cluster as

radio frequency signal paths between each station and its local gateway device and

a further signal path selected by one of the gateway devices from those available within the communications structure supported by the linking data bus.

11. A local communication system comprising:

a. two or more clusters of stations each cluster comprising a plurality of stations interconnected for communicating messages via a respective data bus and in accordance with a respective set of communication protocols, at least one of the respective sets of communication protocols being a first set of communications protocols;

b. a further data bus for interconnecting the clusters, the further data bus not supporting the first set of communication protocols;

c. a plurality of respective gateway devices, one for each cluster, the gateway devices linking the clusters and the further data bus and being operable to enable communications therebetween;

wherein

the first set of communications protocols specifies a maximum time for reply by a first station to a message sent by a second station; and

each respective gateway device that is coupled to a cluster using the first set of communications protocols is configured (I) in response to a message originating station within that cluster, to generate and send a temporary response to the message originating station within a predetermined period less than the specified maximum response time, pending arrival of a response from a message destination station outside that cluster, (ii) during said pendency provide for passage of a message to or from another station of that cluster, and (iii) upon arrival of said response from said message destination station, pass said response to the message originating station

in which a nominated station (the "AV Center")

has knowledge of signal paths in the cluster containing the message originating station;

uses control messages to establish a signal path between the message originating station and the respective gateway device for the cluster containing the message originating station; and

provides information to cause establishment of signal paths

between the message destination station and the respective gateway device for the cluster containing the message destination station; and

between the cluster containing the message originating station and the cluster containing the message destination station via the further bus.

12. A system as claimed in claim 11, in which the gateway of a first cluster is operable to emulate the system outside of its cluster as a station on its cluster data bus and in accordance with the communications protocols supported by that bus.

13. A system as claimed in claim 11, wherein

the signal paths between

the first station and the respective gateway device of the first cluster; and

the second station and the respective gateway device of the second cluster

are both baseband signal paths and

the "AV Centre" has knowledge of the baseband signal paths in both the first and second clusters and uses control messages for both the first and second clusters to establish the signal paths between the first and second stations and the respective gateways of the first and second clusters.

14. A system as claimed in claim 11, wherein

the signal paths between

the first station and the respective gateway device of the first cluster; and

the second station and the respective gateway device of the second cluster

are both baseband signal paths and the "AV Centre"

has knowledge of the baseband signal paths in the first cluster and uses control messages to establish the signal path between the first station and the respective gateway of the first cluster and

provides information to allow a nominated station in the second cluster to establish the signal paths between the stations in the second cluster and the respective gateway device for the second cluster.

15. A system as claimed in claim 11, wherein

the signal path between

the first station and the respective gateway device of the first cluster is a baseband signal path; and

the second station and the respective gateway device of the second cluster is a radio frequency channel;

the nominated station (the "AV Centre")

has knowledge of baseband signal paths in the first cluster and uses control messages to establish the signal path in the first cluster between the first station and the respective gateway device of the first cluster, and additionally

the AV Centre uses control messages to control the appropriate use of a Radio Frequency channel in the second cluster.

16. A system as claimed in claim 11, wherein

the signal path between

the first station and the respective gateway device of the first cluster is a baseband signal path; and

the second station and the respective gateway device of the second cluster is a radio frequency channel;

the nominated station (the "AV Centre")

has knowledge of baseband signal paths in the first cluster and uses control messages to establish the signal path in the first cluster between the first station and the respective gateway device of the first cluster, and additionally

provides information to allow a nominated station in the second cluster to control the appropriate use of a Radio Frequency channel in the second cluster.

17. A system as claimed in claim 11, wherein

the signal paths between

the first station and the respective gateway device of the first cluster; and

the second station and the respective gateway device of the second cluster

are both radio frequency channels;

the nominated station uses control messages to control the appropriate use of a Radio Frequency channel in the first and second cluster.

18. A system as claimed in claim 11, wherein

the signal paths between

the first station and the respective gateway device of the first cluster; and

the second station and the respective gateway device of the second cluster

are both radio frequency channels; and

the nominated station

uses control messages to control the appropriate use of a Radio Frequency channel in the first cluster and

provides information to allow a nominated station in the second cluster to control the appropriate use of a Radio Frequency channel in the second cluster.

19. A gateway device for use in a local communication system, the system including

a plurality of stations interconnected for communicating messages via a first data bus and in accordance with a first set of communication protocols, and

at least one further station not supporting said first set of communication protocols; and wherein

said first set of communication protocols specifies a maximum time for reply by a first station to a message sent by a second station;

said gateway device comprising

means for linking said first data bus and said further station to enable communication therebetween, and

means whereby when a message requiring a response is originated by a station of said plurality of stations and passed to said further station via said gateway, said gateway device (i) generates and sends a temporary response to the originating station within a predetermined period less than the specified maximum response time, pending arrival of a response from said further station, (ii) during said pendency, provides for passage of a message to or from another station of the plurality of stations, and (iii) upon arrival of said response from said further station, passes said response to said originating station.

* * * * *

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Eytchison

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(45) **Date of Patent: Mar. 26, 2002**

(54) **METHOD OF MANAGING RESOURCES WITHIN A NETWORK OF CONSUMER ELECTRONIC DEVICES**

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(73) Assignees: **Sony Corporation of Japan**, Tokyo (JP); **Sony Electronics, Inc.**, Park Ridge, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(51) **Int. Cl.**[7] **G06F 9/00**
(52) **U.S. Cl.** **709/313**; 709/312; 709/314; 709/315; 709/316; 709/317; 709/318; 709/245
(58) **Field of Search** 709/313, 245, 709/314, 315, 316, 317, 318, 323; 725/78, 79, 80, 81, 82, 95, 96; 370/352, 468

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,893,199	A		1/1990	Okada 360/48
5,420,573	A		5/1995	Tanaka et al. 340/825.24
5,537,605	A		7/1996	Teece 395/800
5,671,225	A	*	9/1997	Hooper et al. 370/468
5,678,041	A		10/1997	Baker et al. 395/609
5,696,898	A		12/1997	Baker et al. 395/187.01
6,275,865	B1	*	11/1998	Zou 709/313
5,875,395	A	*	2/1999	Holmes 455/420
5,886,995	A	*	3/1999	Arsenault et al. 370/477
5,892,900	A		4/1999	Ginter et al. 395/186
5,926,476	A	*	7/1999	Ghaibeh 370/395
5,933,498	A		8/1999	Schneck et al. 380/4
5,935,206	A	*	8/1999	Dixon et al. 709/219
5,960,445	A		9/1999	Tamori et al. 707/203
6,005,861	A	*	12/1999	Humpleman 370/352
6,065,055	A		5/2000	Hughes et al. 709/229
6,219,840	B1	*	4/2001	Corrigan et al. 725/117
6,272,127	B1	*	8/2001	Golden et al. 370/352

OTHER PUBLICATIONS

Sony et ak.; "The HAVI Architecture"; Specification of the Home Audio/Video Interoperability (HAVI) Architecture; Mat 11, 1998; Copyright 1997, 1998; Ver. 0.8.

Soney et al.; "The HAVI specification"; Specification of the Home Audio/Video Interoperability (HAVI) Architecture; Nov. 19, 1998, Ver. 1.0 beta.

* cited by examiner

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Assistant Examiner—Chuong Ho
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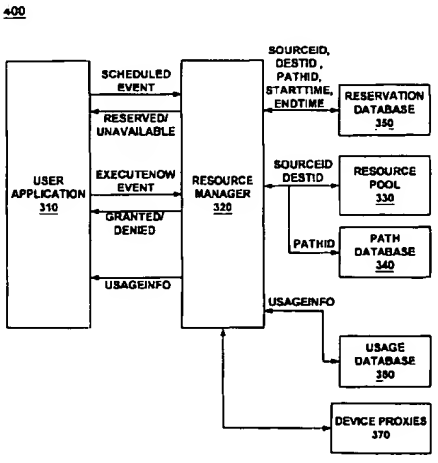
(57) **ABSTRACT**

A method of managing resources within a network for consumer electronic media devices. In one embodiment, the method is implemented as a software resource manager which provides a centralized resource allocation, reservation and access control functionalities for a home entertainment server. Particularly, user applications of the home server receive instructions from a user or other entities for a media service, and converts the instructions into a request that identifies the necessary resources for providing the media service. The software resource manager then determines whether such resources are available upon receiving the request. Importantly, the software resource manager also determines whether a routing path between the necessary resources has sufficient bandwidth for performing the requested media service. If necessary resources and bandwidth are available, the software resource manager then sends control signals to the source and destination devices causing them to perform the requested media services. Additionally, the software resource manager of the present invention provides event scheduling and request arbitration functionalities to the home entertainment server. In this manner, a secure home entertainment network that is protected from misuse and abuse can thus be achieved.

21 Claims, 6 Drawing Sheets



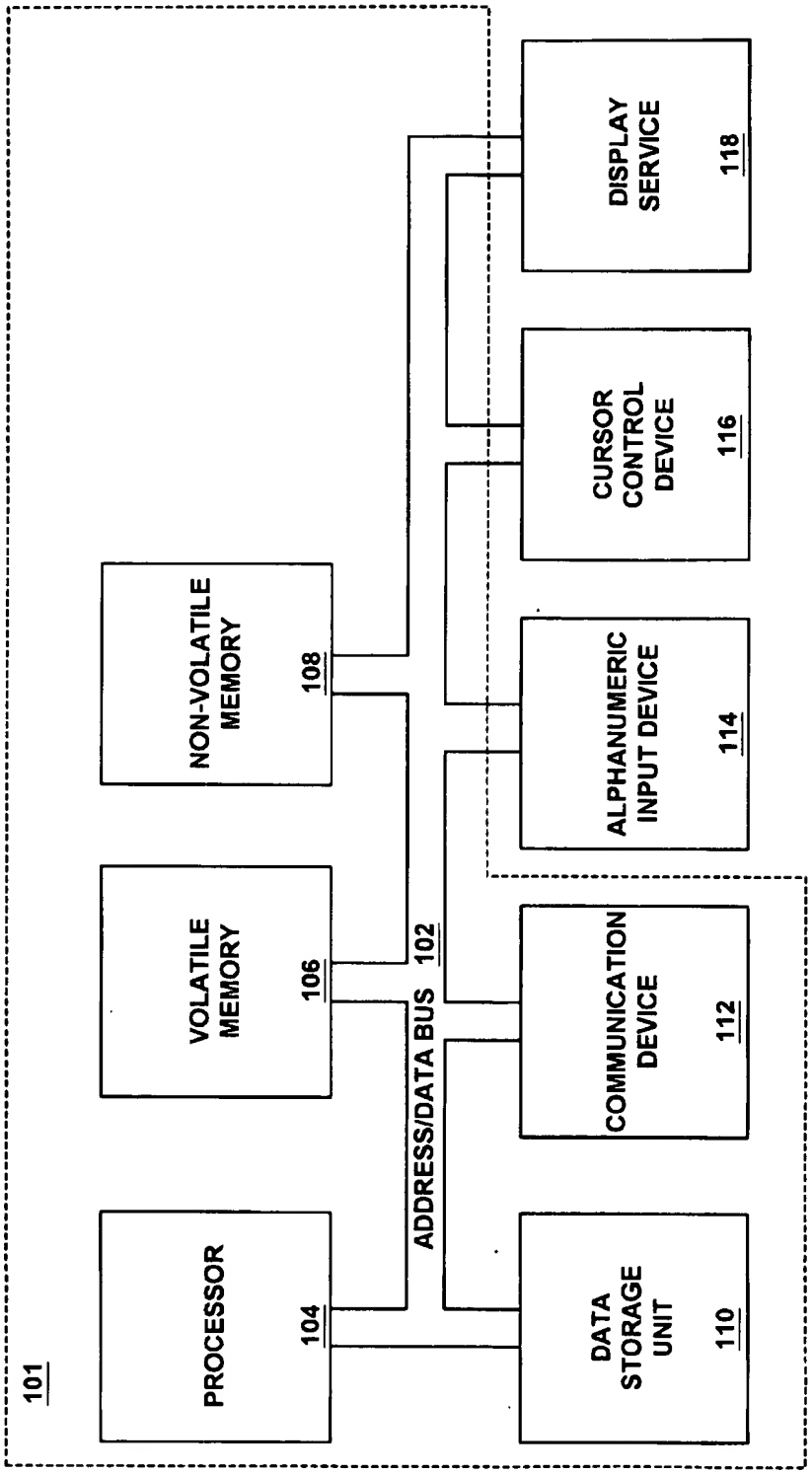
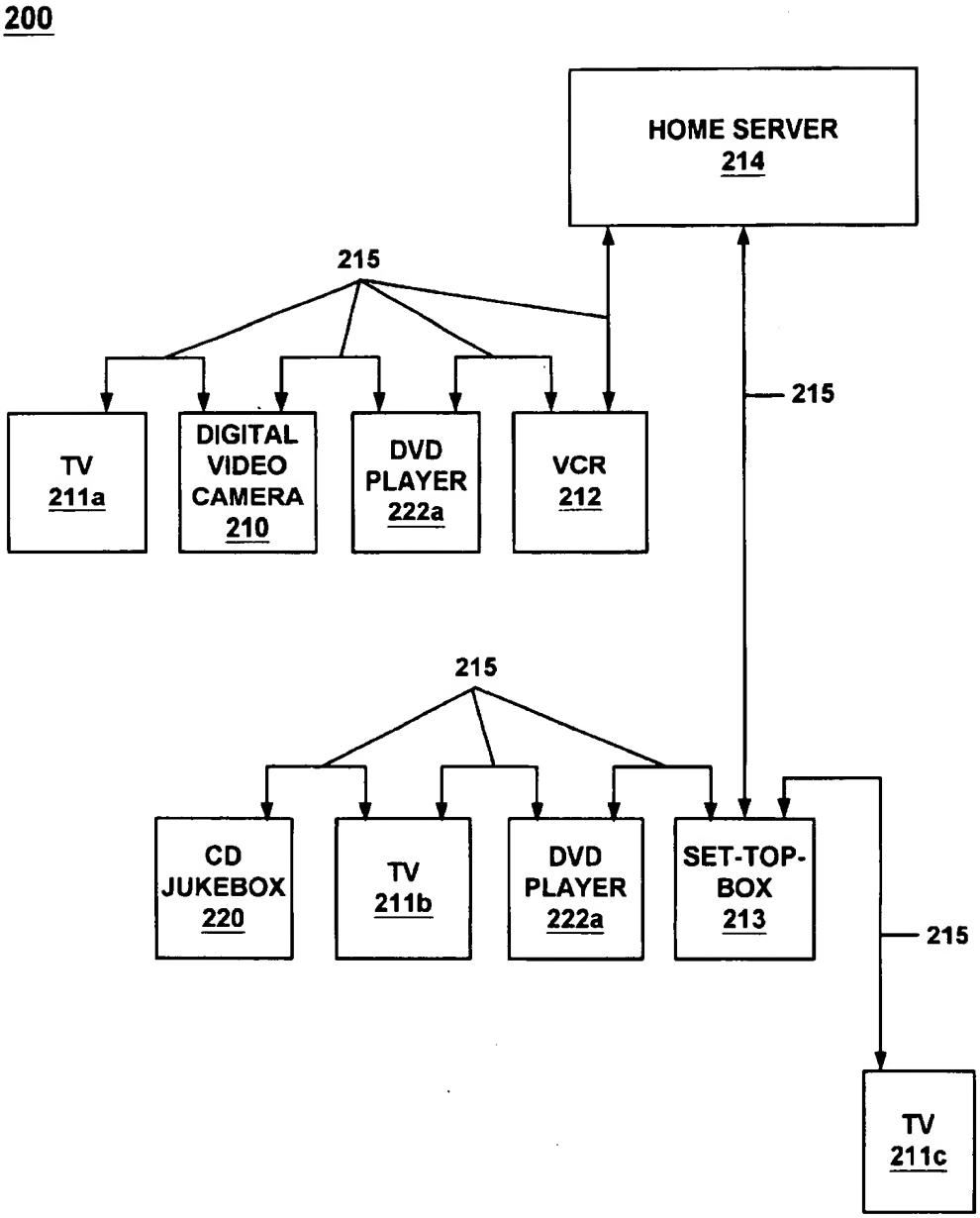

101
PROCESSOR 104
VOLATILE MEMORY 106
NON-VOLATILE MEMORY 108
ADDRESS/DATA BUS 102
DATA STORAGE UNIT 110
COMMUNICATION DEVICE 112
ALPHANUMERIC INPUT DEVICE 114
CURSOR CONTROL DEVICE 116
DISPLAY SERVICE 118

FIGURE 1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215
TV
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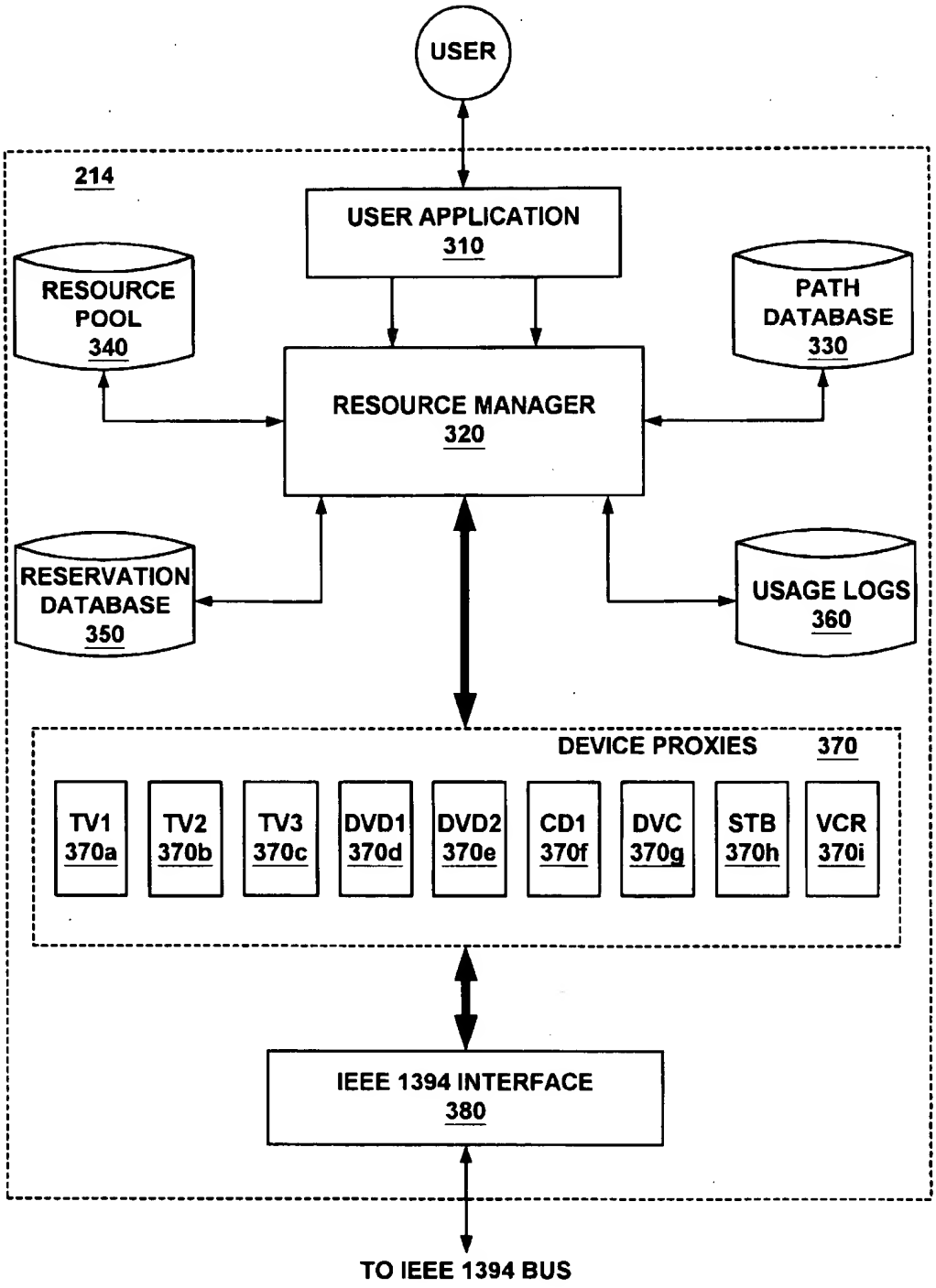
FIGURE 2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RESERVATION DATABASE
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370
TV1
370a
TV2
370b
TV3
370c
DVD1
370d
DVD2
370e
CD1
370f
DVC
370g
STB
370h
VCR
370i
IEEE 1394 INTERFACE
380
TO IEEE 1394 BUS

FIGURE 3

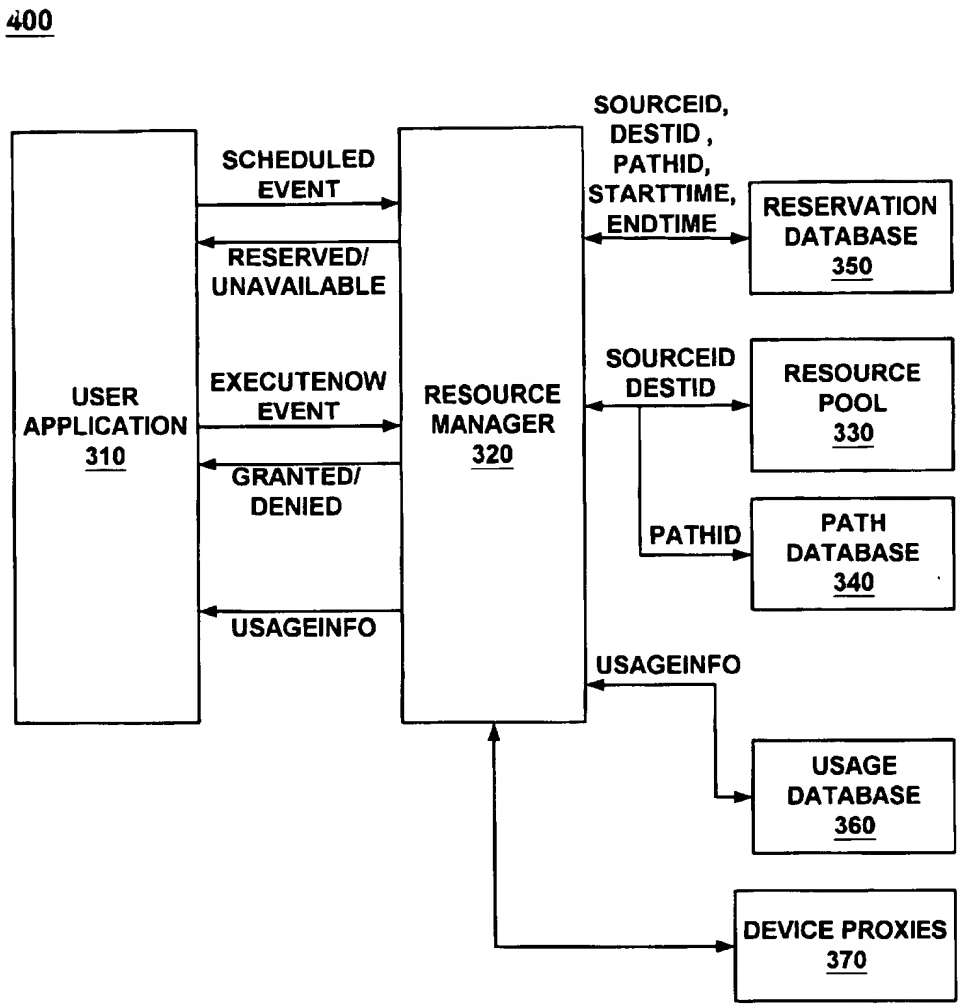
400
USER APPLICATION 310
SCHEDULED EVENT
RESERVED/ UNAVAILABLE
EXECUTENOW EVENT
GRANTED/ DENIED
USAGEINFO
RESOURCE MANAGER 320
SOURCEID, DESTID, PATHID, STARTTIME, ENDTIME
RESERVATION DATABASE 350
SOURCEID DESTID
RESOURCE POOL 330
PATHID
PATH DATABASE 340
USAGEINFO
USAGE DATABASE 360
DEVICE PROXIES 370

FIGURE 4

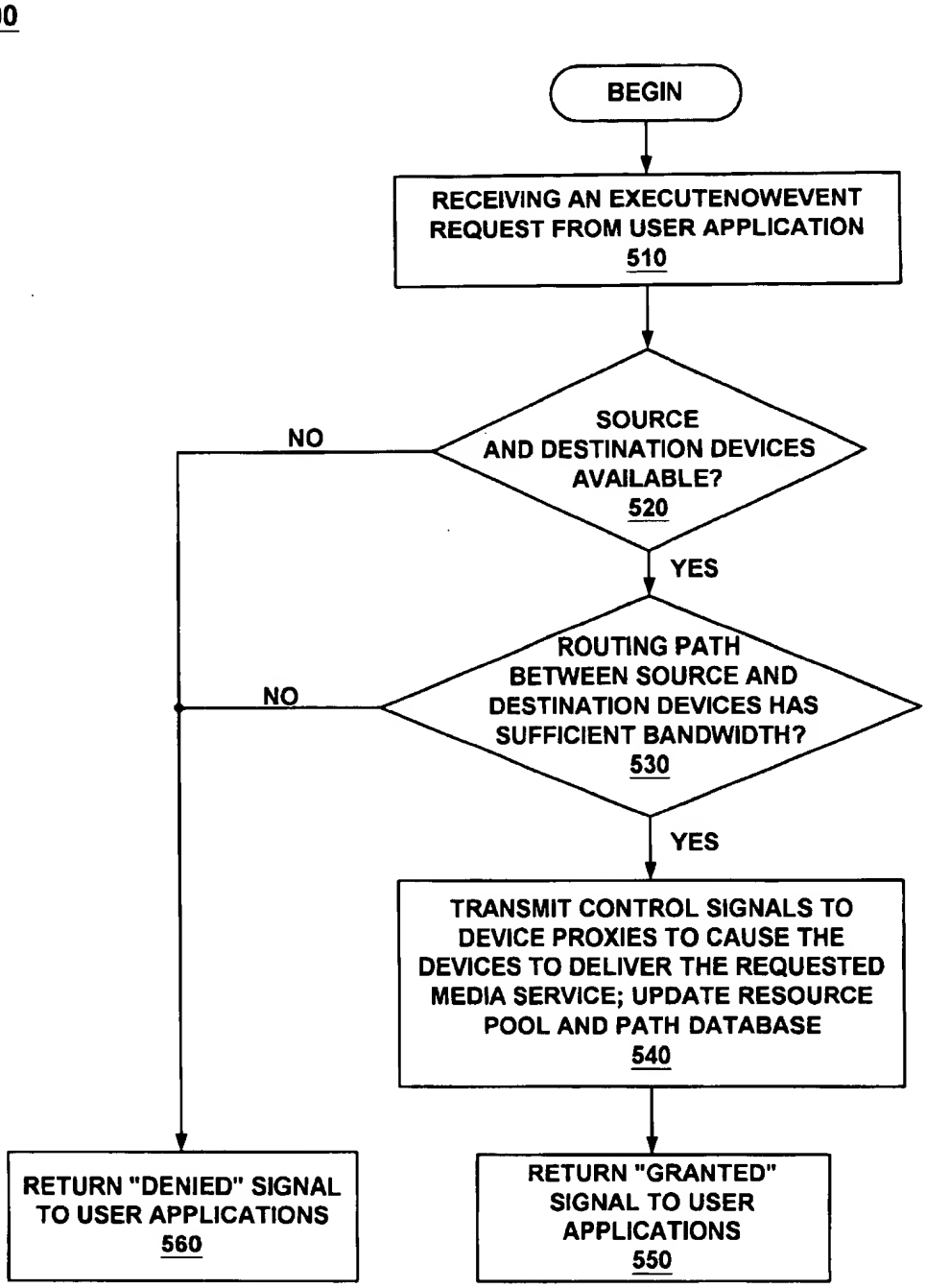
500
BEGIN
RECEIVING AN EXECUTENOWEVENT REQUEST FROM USER APPLICATION
510
SOURCE AND DESTINATION DEVICES AVAILABLE?
520
NO
YES
ROUTING PATH BETWEEN SOURCE AND DESTINATION DEVICES HAS SUFFICIENT BANDWIDTH?
530
NO
YES
TRANSMIT CONTROL SIGNALS TO DEVICE PROXIES TO CAUSE THE DEVICES TO DELIVER THE REQUESTED MEDIA SERVICE; UPDATE RESOURCE POOL AND PATH DATABASE
540
RETURN "GRANTED" SIGNAL TO USER APPLICATIONS
550
RETURN "DENIED" SIGNAL TO USER APPLICATIONS
560

FIGURE 5

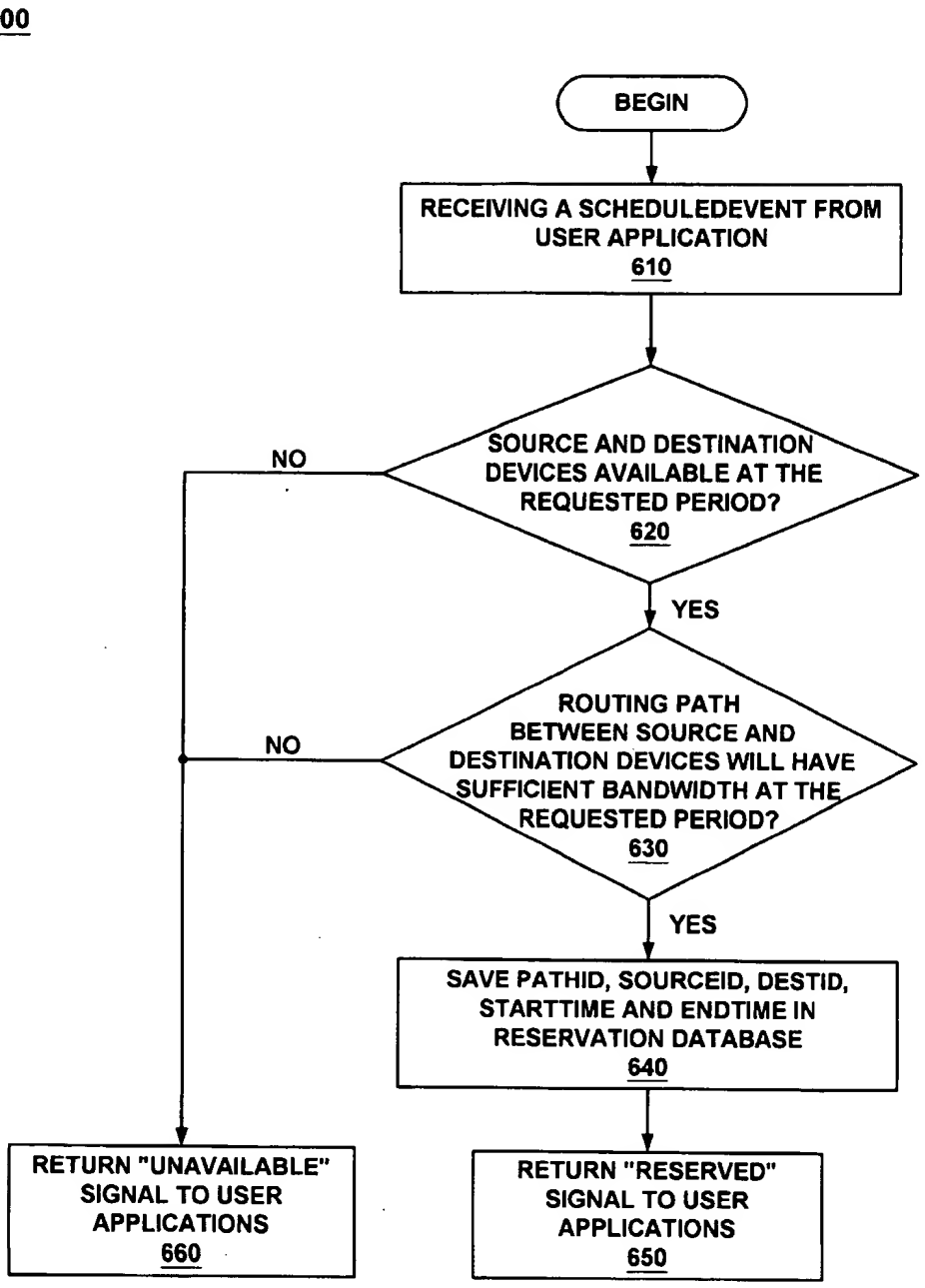
600
BEGIN
RECEIVING A SCHEDULEDEVENT FROM USER APPLICATION
610
SOURCE AND DESTINATION DEVICES AVAILABLE AT THE REQUESTED PERIOD?
620
NO
YES
ROUTING PATH BETWEEN SOURCE AND DESTINATION DEVICES WILL HAVE SUFFICIENT BANDWIDTH AT THE REQUESTED PERIOD?
630
NO
YES
SAVE PATHID, SOURCEID, DESTID, STARTTIME AND ENDTIME IN RESERVATION DATABASE
640
RETURN "UNAVAILABLE" SIGNAL TO USER APPLICATIONS
660
RETURN "RESERVED" SIGNAL TO USER APPLICATIONS
650

FIGURE 6

METHOD OF MANAGING RESOURCES WITHIN A NETWORK OF CONSUMER ELECTRONIC DEVICES

FIELD OF THE INVENTION

The present invention pertains generally to the field of consumer electronic devices. More specifically, the present invention pertains to the field of networked consumer electronic media devices.

BACKGROUND OF THE INVENTION

A home entertainment system typically includes a number of consumer electronic media devices such as televisions, compact disc (CD) players, tuners, digital video disc (DVD) players, a video cassette recorders (VCRs) and high-fidelity speakers. Many sets of wires are usually required to connect these components together to provide the desired functionality. For example, a set of wires is required for connecting the DVD player to the TV and another set of wires is required for connecting the DVD player to the tuner. Yet another set of wires is required for connecting the tuner to the speakers. Most of these devices only have a limited number of inputs and outputs for connecting to other devices. Thus, it is not surprising that most home entertainment systems include only a handful of different devices.

Recently, a class of consumer electronic media devices has been introduced that can be networked together using a standard communication protocol layer (e.g., IEEE 1394 communication standard). The IEEE 1394 standard is an international standard for implementing an inexpensive high-speed serial bus architecture which supports both asynchronous and isochronous format data transfers. The IEEE 1394 standard provides a high-speed serial bus for interconnecting digital devices thereby providing universal input/output connection. The IEEE 1394 standard defines a digital interface for applications thereby eliminating the need for an application to convert digital data to an analog form before it is transmitted across the bus. Correspondingly, a receiving application will receive digital data from the bus, not analog data, and will therefore not be required to convert analog data to digital form. The IEEE 1394 standard is ideal for consumer electronics communication in part because devices can be added to or removed from the serial bus while the bus is active. If a device is so added or removed, the bus automatically reconfigures itself for transmitting data between the then existing devices. Each device on the bus is a "node" and contains its own address space.

The provision of the IEEE 1394 serial communication bus for networking consumer electronic devices has allowed the development of a home entertainment network that consists of a large number of consumer electronic devices. In addition, the provision of the IEEE 1394 serial bus enables a single source device to provide content to multiple destination devices. For example, a DVD player located in the living room can be shared by multiple TV sets located in the bedrooms and in the kitchen. However, one problem associated with sharing source devices within the home entertainment network is that multiple users may want to use the same source devices at the same time. Therefore, it would be advantageous to provide an access control system that allocates control of the devices intelligently.

Another problem associated with such a home entertainment network is bandwidth contention. For example, if many TV sets and DVD players are connected to the home network, the IEEE 1394 serial bus may not have sufficient bandwidth to support multiple simultaneous isochronous

channels for multiple video streams. Therefore, it would be advantageous to provide a method of managing a network of consumer electronic media devices. It would also be advantageous to provide a method of managing resources within a network of consumer electronic media devices such that the problem of bandwidth contention is addressed.

Yet another problem associated with a home entertainment network is that, since media (e.g., CDs, DVDs) are distributed across the network, it is burdensome for a user to locate the desired media. For example, a home entertainment network may include several DVD players and DVD juke-boxes each capable of holding hundreds of DVDs. It would be difficult for a user to browse through every devices to locate the desired DVD. Therefore, it would be advantageous to provide a method of managing resources within the home network such that complicated management and control of the devices are hidden from the users.

Another problem associated with the home entertainment network is that, when connected to the Internet, the consumer electronic devices and information contained therein may become compromised due to unauthorized access from third party users (e.g., hackers). Therefore, it would be advantageous to provide a method of managing resources within the home network such that the devices are protected from misuse and unauthorized accesses.

SUMMARY OF THE DISCLOSURE

Accordingly, the present invention provides for an intelligent centralized resource allocation, reservation and access control system for a home entertainment network. Furthermore, the present invention provides for a method of managing resources within a home entertainment network such that accesses to resources are granted based on access rights associated with each resource. Applications attempting to access the devices of the network must do so through a software resource manager. The present invention also provides for a method of managing resources within the home entertainment network such that media-services can be delivered to a user without requiring the user to directly control the devices.

In furtherance of the present invention, the home entertainment network includes a plurality of consumer electronic media devices (e.g., Digital Video Disc Players, TVs, etc.) and a home entertainment server coupled together via high speed connections such as the IEEE 1394 bus. Particularly, user applications of home entertainment network have no direct control over the devices. Rather, user applications can only request the software resource manager, which has complete control over all the devices, to provide the media service. The software resource manager then determines whether the devices necessary for providing the media service are available. Importantly, the software resource manager also determines whether a routing path between the necessary devices has sufficient bandwidth for providing the requested media service. If necessary devices and bandwidth are available, the software resource manager then sends control signals to the devices and causes them to provide the requested media services. In this manner, resources of the home entertainment network are hidden from the users and other user applications. Because the devices are isolated from the user applications, a secure home entertainment network can also be achieved.

In one embodiment of the present invention, the software resource manager maintains a resource database for tracking availability of the consumer electronic devices of the home entertainment network. Once a device is in-use, or otherwise

becomes unavailable, the device is removed from the resource database. When the device becomes available again, it is added to the resource database. In this way, the software resource manager can easily determine the availability of the devices. The software resource manager further maintains a path database for tracking the availability of the routing paths between the devices. The path database stores all possible routing paths between all the devices and the bandwidth requirements for all the devices. With such information, the software resource manager can then readily determine whether the network can provide sufficient bandwidth to deliver the requested media service.

In accordance with another embodiment of the present invention, the software resource manager provides a reservation database for storing resource reservation information. In this embodiment, the resource manager is configured for receiving a request for a future media service. The request is then stored within the reservation database. The home server of the present invention further provides a scheduler for scheduling the execution of the requested media service at a future time.

These and others advantages of the present invention not specifically mentioned above will become clear within discussions presented herein.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention:

FIG. **1** is a block diagram illustrating components of a home server in accordance with the present invention.

FIG. **2** illustrates an exemplary home entertainment network in which embodiments of the present invention may be practiced.

FIG. **3** is a logical block diagram of the software processes of a home server illustrated in FIG. **2** in accordance with the present invention.

FIG. **4** is a data flow diagram illustrating the detailed communication protocol between user application and software resource manager illustrated in FIG. **3** in furtherance of the present invention.

FIG. **5** is a flow diagram illustrating steps of the process of managing network resources according to an embodiment of the present invention.

FIG. **6** is a flow diagram illustrating steps of the process of reserving network resources according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following detailed description of the preferred embodiments, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that the present invention may be practiced without these specific details. In other instances, well-known structures and devices are not described in detail in order to avoid obscuring aspects of the present invention.

I. COMPUTER SYSTEM ENVIRONMENT OF THE PRESENT INVENTION

Some portions of the detailed descriptions which follow are presented in terms of procedures, steps, logic blocks, processing, and other symbolic representations of operations on data bits within a computer memory. These descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. A procedure, computer executed step, logic block, process, etc., is here and generally conceived to be a self-consistent sequence of steps of instructions leading to a desired result. The steps are those requiring physical manipulations of data representing physical quantities to achieve tangible and useful results. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers or the like.

It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussions, it is appreciated that throughout the present disclosure, discussions utilizing terms such as "collecting", "computing", "determining", "grouping", "mapping", "assigning" or the like, refer to the actions and processes of a computer system, or similar electronic computing device. The computer system or similar electronic device manipulates and transforms data represented as electronic quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission, or display devices.

Specific aspects of the present invention are operable within a home server system. In general, a home server (or other intelligent electronic device such as a set-top-box) for the home entertainment network in accordance with the present invention includes a general purpose computer system **101** operable as a platform to implement and support elements of the present invention. As shown in FIG. **1**, computer system **101** includes an address/data bus **102** for communicating information including address, data, and control signals, a central processor **104** coupled with bus **102** for processing information and instructions, a volatile memory **106** (e.g., random access memory RAM) coupled with the bus **102** for storing information and instructions for the central processor **104** and a non-volatile memory **108** (e.g., read only memory ROM) coupled with the bus **102** for storing static information and instructions for the processor **104**, a data storage device **110** such as a magnetic or optical disk and disk drive coupled with the bus **102** for storing information and instructions, an optional display device **118** coupled to the bus **102** for displaying information to the computer user, an optional alphanumeric input device **114** including alphanumeric and function keys coupled to the bus **102** for communicating information and command selections to the central processor **104**, an optional cursor control or directing device **116** coupled to the bus **102** for communicating user input information and command selections to the central processor **104**, and a communication device **112** coupled to the bus **102** for communicating signals that are input and output from the system **101**. The communication device **112** is configured for connecting to a home entertainment network via an IEEE 1394 serial communication bus **215**. Computer **101** may further include another communication device (e.g., a modem) for connecting the home network to the Internet.

Program instructions executed by the home server **101** can be stored in computer usable memory units such as

RAM **106**, ROM **108**, or in the storage device **110**, and when executed in a group can be referred to as logic blocks or procedures. It is appreciated that data produced at the various stages of the present invention, including path availability information and resource availability information, can also be stored in RAM **106**, ROM **108** or the storage device **110** as shown in FIG. **1**.

The display device **118** of FIG. **1** utilized with the computer system **101** of the present invention is optional and may be a flat panel liquid crystal display (LCD) device, a TV, a personal digital assistant (PDA) or other display device suitable for creating graphic images and alphanumeric characters recognizable to the user. The cursor control device **116** allows the computer user to dynamically signal the two dimensional movement of a visible pointer on a display screen of the display device **118**. Many implementations of the cursor control device are known in the art including a trackball, mouse, joystick or special keys on the alphanumeric input device **114** capable of signaling movement of a given direction or manner of displacement.

II. NETWORK ENVIRONMENT IN ACCORDANCE WITH THE PRESENT INVENTION

FIG. **2** illustrates an exemplary home entertainment network **200** in which the present invention may be practiced. Exemplary network **200** includes consumer electronic media devices (including computer systems) as nodes but could be extended equally well to cover other electronic devices. Exemplary network **200** includes a digital video camera **210**, a video cassette recorder (VCR) **212**, a home server **214**, a set-top-box **213**, television sets (TVs) **211***a*–**211***c*, a compact disc (CD) jukebox **220** and DVD players **222***a*–**222***b* connected together by IEEE 1394–1995 (IEEE 1394) bus **215**. The set-top-box **213** can be coupled to receive media from a cable TV system. The IEEE 1394 bus lines, or "cables," allow the consumer electronic media devices to transmit data, commands and parameters to other devices of the network **200**.

It should be noted that home network **200** illustrated in FIG. **2** is exemplary only and that an audio/video network in accordance with the present invention could include many different combinations of components. It should also be appreciated that consumer electronic devices of the network **200** may be accessed via user applications such as a web-browser.

The IEEE 1394 communication standard within network **200** of FIG. **2** supports isochronous data transfers of digital encoded information. Isochronous data transfers are real-time transfers which take place such that the time intervals between significant instances have the same duration at both the transmitting and receiving applications. Each packet of data transferred isochronously is transferred in its own time period. An example of a "real-time" application for the transfer of data isochronously is from VCR **212** to TV **211***a* of FIG. **2**. The VCR **212** records images and sounds and saves the data in discrete packets. The VCR **212** then transfers each packet, representing the images and sounds recorded over a limited time period, during that time period, for display by the TV **211***a*. The IEEE 1394 standard bus architecture provides multiple channels for isochronous data transfers between applications. Specifically, a six bit channel number is broadcast with the data to ensure reception by the appropriate application. This feature of the IEEE 1394 bus allows multiple devices to simultaneously transmit isochronous data across the bus structure. This feature also enables media (e.g., CDs, DVDs, video cassettes, etc.) to be distributed across the home network **200**. Further, this feature enables the devices of the home entertainment network **200** to be distributed across the home.

III. RESOURCE MANAGER ACCORDING TO THE PRESENT INVENTION

A feature of the present invention is that all resources of a home entertainment network (e.g., devices, routing paths between devices, etc.) are controlled and managed by a software resource manager. According to one embodiment of the present invention, a home network resource is defined to be the physical devices that are capable of transporting, housing, and displaying content. This means that if the device is actively generating content or controlling information (via the device or a device proxy), the software resource manager is free to signal the device to stop producing content or to redirect the content to another destination.

Further, any application programs (e.g., web-browsers) that use or attempt to use the resources are required to communicate with the software resource manager. Generally, direct communication between the application programs and the devices or device proxies is not allowed. An application program is only allowed to request the software resource manager to control the devices. By inserting a control layer between application programs and the device proxies, the devices will be protected against misuse and abuse (e.g., unauthorized access or modification). Additionally, the software resource manager provides other useful functions such as resource allocation and resource reservation.

FIG. **3** is a logical block diagram of the software processes of a home server **214** in accordance with the present invention. As illustrated, software processes of home server **214** include a user application **310**, a resource manager **320**, a path database **330** and a resource pool **340**. Software processes of the home server **214** further include a reservation database **350** and a usage log **360**. Home server **214** further includes a plurality of software device proxies **370***a*–**370***i* each for controlling one of the devices of home entertainment network **200**. For example, software device proxy **370***c* is for controlling TV **211***c*, and device proxy **3701** is for controlling VCR **212**, etc., that are coupled to the IEEE 1394 bus interface **380**. In one embodiment of the present invention, the software device proxies **370** may include HAVI Device Control Modules (DCMs) and Functional Control Modules (FCMs).

Significantly, according to the present invention, user application **310** is not allowed to communicate directly with software device proxies **370**. Rather, user application **310** communicates to the resource manager **320** when it intends to access one of the network consumer electronic media devices. Particularly, user application **310** receives instructions from a user or other entities for a media service, and converts the instructions into a request that identifies the necessary resources for providing the media service. In the following discusion, a media service is defined as content that is displayed or actions that are performed on behalf of the users. For example, an external sensor triggering digital video camera **210** to capture video would be considered a media service.

In the present embodiment, the user application **310** of FIG. **3** sends the request to the resource manager **320** in the form of an event list that indicates the source device, the destination device and the requested action. Thereafter, the

resource manager **320** determines the availability of the source and destination devices, and checks whether sufficient bandwidth is available for carrying out the requested action. If the devices and the bandwidth are available, the resource manager **320** will return a "granted" signal and transmits the necessary control commands to the software device proxies **370***a*–**370***i*. The software device proxies **370***a*–**370***i* then control the devices via IEEE 1394 bus interface **380**. If the devices or the requisite bandwidth are not available, the resource manager **320** will return a "denied" signal to the user application **310**.

Importantly, according to the present invention, resource manager **320** allows the resources of home network **200** to be checked-in or checked-out independent of application requests. At any time, the resource manager **320** can reclaim checked-out resources and reallocate them to other users. Likewise, a reserved resource can be reclaimed and reallocated to other users or reallocate them back into the resource pool **340**.

According to the present invention, the resource manager **320** of FIG. **3**, upon initialization of the home server **214**, scans the home network **200** and determines all the available resources. Data representative of the routing paths and their bandwidths are then stored within path database **330**. Data representative of the available devices are stored within resource pool **340**. As the resources of the home network **200** changes, the resource manager **320** modifies the path database **330** and the resource pool accordingly.

User application **310** may also send a request for media services to be delivered at a future time. In the present embodiment, the request is in the form of a scheduled-event list. Particularly, the scheduled-event list may indicate the time the scheduled-event is to be performed, and the necessary routing paths and device information. The resource manager **320**, upon receiving the scheduled-event list, then checks the reservation database **350** to determine whether the devices and the routing paths have already been reserved by other processes. If not, the resource manager **320** then enters the devices and routing paths within the reservation database **350**. The resource manager **320** also accesses a scheduler (not shown) to schedule the future execution of the scheduled-event list.

Usage information of the network is stored within usage log **360** of FIG. **3**. According to the present invention, every time a request for media service is granted, the event list is stored within the usage log **360**. The usage information can be used to track warranty information of the devices. In addition, the usage information can be used to track the network usage of each user. The usage information may also be used by the resource manager **320** for restricting access to certain users who have exceeded their usage limitation.

FIG. **4** is a logical block diagram **400** illustrating the data flow between user application **310** and resource manager **320** in accordance with the present invention. Data flows between resource manager **320** and reservation database **350**, resource pool **330**, path database **340**, usage log **360** and device proxies **370** are also illustrated. Resource manager **320** stores device usage information within the usage log **360**. In addition, the resource manager **320** may send a UsageInfo to the user application **310** when prompted.

FIG. **5** is a flow diagram illustrating the steps of a process **500** for managing network resources according an embodiment of the present invention. The process **500** is described in conjunction with FIG. **4**. As illustrated, at step **510**, resource manager **320** receives an ExecuteNowEvent request from the user application **310**. According to the present invention, the ExecuteNowEvent request consists of information regarding the source device (SourceID), the destination device (DestID) and the routing path between the source device and the destination device (PathID). The ExecuteNowEvent request may further include information such as the identification of the user making the media service request.

At step **520** of FIG. **5**, the resource manager **320**, upon receiving the ExecuteNowEvent request, looks up the resource pool **330** and determines if the requested source and destination devices are available. According to the present invention, the resource pool **330** is a list of all devices connected to the network and is constructed upon initialization of the home server **210**. The resource pool **330** is also continuously updated to keep track of devices that are added to and removed from the home entertainment network **200**. If the source and destination devices are already in-use by other users or user applications, a "Denied" signal is returned to the user application **310** at step **560**.

At step **530**, the resource manager **320** looks up the path database **340** to determine if there is sufficient bandwidth between the source device and the destination device. In the present embodiment, the path database **340** is a table for identifying the bandwidth requirements for all possible routing paths between the devices. Methods of calculating and determining the bandwidth requirements for all possible routing paths between the devices are well known in the art, and are therefore, not described herein to avoid obscuring aspects of the present invention. If the resource manager **320** determines that insufficient bandwidth is available, the resource manager **320** returns a "Denied" signal to the user application **310** at step **560**. If the requested resources are available, sends control signals to the device proxies **370** and causes the devices to carry out the media service request immediately at step **540**, and returns a "Granted" signal to the user application **310** at step **550**. In addition, the source devices and destination devices are removed from the resource pool **330**, and the path database is updated to reflect the bandwidth usage at step **540**.

FIG. **6** is a flow diagram illustrating the steps of a process **600** for reserving network resources according to an embodiment of the present invention. The process **600** is described also in conjunction with FIG. **4**. As illustrated, at step **610**, resource manager **320** receives an ScheduledEvent request from the user application **310**. According to the present invention, the ScheduledEvent request consists of information regarding the source device (SourceID), the destination device (DestID), the routing path between the source device and the destination device (PathID) and the start time (StartTime) and end time (EndTime) of the scheduled event. The ScheduledEvent request may further include information such as the identification of the user making the media service request.

In another embodiment of the present invention, ScheduledEvent request may include two types of requests: ExecuteWaliClockEvent and ExecuteCalendarEvent. The ExecuteWallClockEvent request is for scheduling future execution of requests based on a 24-hr clock. The ExecuteCalendarEvent is for scheduling future execution of requests based on the calendar. For example, the ExecuteWallClockEvent request is used for scheduling the recording of the "Evening News" at 6:00 pm in the evening everyday. As another example, the ExecuteCalendarEvent request is used for scheduling the backing-up of the home computer system every Sunday.

At step **620** of FIG. **6**, the resource manager **320**, upon receiving the ScheduledEvent request, looks up the reser-

vation database **350** and determines if the requested source and destination devices are available. If the source and destination devices are already reserved by other users or other user applications, an "Unavailable" signal is returned to the user application **310** at step **660**.

At step **630**, the resource manager **320** looks up the path database **340** to determine if other reservations would affect the bandwidth of the routing path between the source device and the destination device at the request period. If the resource manager **320** determines that the routing path will be affected, the resource manager **320** returns a Failure signal to the user application **310** at step **660**. If it is determined that the routing path will not be affected, the resource manager **320** then stores the SourceID, DestID, PathID, StartTime and EndTime within the reservation database **350** at step **640**, and returns a "Reserved" signal to the user application **310** at step **650**.

IV. ADDITIONAL FEATURES OF THE RESOURCE MANAGER OF THE PRESENT INVENTION

A. Enforcing Access Restrictions

The resource manager **320** of the present invention, when used in conjunction with other software processes of the home server **214** (e.g., Access Control Manager (ACM) and Media Binding Agent (MBA)), can be used for enforcing access restrictions. For instance, the ACM may provide user information (e.g., age of users) to the resource manager **320** and the MBA may provide meta-information (e.g., rating information) of the content of the requested media service to the resource manager **320**. Access policies may be implemented within the user application **310** or the resource manager **320** to restrict access to the media contained within the devices even though the resources are available. For example, if an access policy may be implemented within resource manager **320** to prohibit users under age 13 from watching watch "R" rated movies. It is the responsibility of the resource manager **320** to enforce these access policies.

B. Conflict Resolutions

Another responsibility of the resource manager **320** is to perform conflict resolutions. If a user with a higher privilege wants to access a service originating from a single threaded device that is in use by another user with a lower privilege, the resource manager **320** attempts to resolve the conflict. It will send out a message informing the (source/destination) device is in use, and queries the more privileged user whether he/she desires to override the on-going service. A message notifying the user with the lower privilege may be sent indicating that their service is being terminated. When resources become available, the user with the lower privilege is free to re-reschedule the service. As long as there are limited resources and multiple service requests, only the service request with a higher priority will be serviced. In cases where multiple services with identical priorities request the same single threaded resources, a first come first serve policy will be observed.

C. Resource Locking

Another feature of the resource manager **320** is locking resources whereby users with lower privileges cannot access services and resources. For instance, a parent may prevent a specific category of music from playing in the home or may disallow TV viewing between the hours of 7:00 AM to 5:00 PM. With this feature, the parent can allocate services to children based on time slots. For example, a child be allowed to watch TV for 10 hours a week. The child is free to spend the 10 hours anyway, he/she feels fit. Once the 10 hours are consumed, no more TV time is permitted. The parent may put restrictions on the 10 hours of viewing time by preventing certain channels from being viewed and disallowing certain viewing hours.

D. Attribute Control

Another feature of the resource manager **320** is to control specific attributes of a resource device once a service has started. An example of this feature is regulating volume controls for a music category (e.g., rap, rock, etc.). This can be done for specific locations in a home or for all locations. If a child's room is the designation location for "rap" music and the resource manager **320** has previously configured the child's room for volume control, when the rap music plays in that room the volume controls will be regulated. A parent may want such volume control to prevent base waves from reverberating throughout the house. The resource manager **320** accomplishes this task by detecting the service category for the child's room and regulating volume control on the designation device.

The attribute control functionality of the resource manager **320** may also be used to augment a service. For example, if a user is watching a horror movie in the family room, the resource manager **320** can draw the drapes and dim the lights (provided that the drape controls and the light controls are connected to the home network **200**) while the movie is playing. As another example, if a telephone call is detected in the room where the movie is being viewed, the resource manager **320** can pause the movie and turn the lights on.

The present invention, a computer implemented process for managing resources within a home entertainment network, has thus been described. By providing a centralized resource allocation and access control system, security of the home entertainment network can be achieved. While the present invention has been described in particular embodiments, it should also be appreciated that the present invention should not be construed as limited by such embodiments, but should be construed according to the below claims.

What is claimed is:

1. A method of managing resources within a network including a plurality of consumer electronic media devices, said method comprising the steps of:

a) providing a resource manager for manging resources within said network;

b) receiving a request for a media service, said request identifying a source consumer electronic media device and a destination consumer electronic media device that are necessary for performing said media service;

c) based on said request, said resource manager determining whether said source consumer electronic media device and said destination consumer electronic device are available for performing said media service;

d) said resource manager determining whether a routing path between said source and said destination consumer electronic media devices has sufficient bandwidth for performing said media service; and

e) provided said source electronic media device and said destination electronic media device are available and provided said routing path has sufficient bandwidth, said resource manager transmitting control signals to cause said plurality of consumer electronic media devices to provide said media service.

2. The method as recited in claim **1** further comprising the step of returning a failure message provided said routing path does not have sufficient bandwidth for performing said media service.

3. The method as recited in claim 1 further comprising the steps of:

constructing a list having a plurality of entries each corresponding to a respective one of said plurality of consumer electronic media devices;

removing one of said entries from said list when a corresponding one of said plurality of consumer electronic media devices becomes unavailable; and

adding a new entry to said list when one of said plurality of consumer electronic media devices becomes available.

4. The method as recited in claim 1 further comprising the steps of:

constructing a list having a plurality of entries each corresponding to a respective one of a plurality of routing paths connecting consumer electronic media devices of said network;

determining bandwidth requirements for said routing paths of said network and generating data representative thereof; and

storing said data into a path database.

5. The method as recited in claim 4 further comprising the steps of:

removing one of said entries from said list when a corresponding one of said plurality of routing paths becomes unavailable; and

adding a new entry to said list when said corresponding routing path becomes available.

6. The method as recited in claim 1 further comprising the step of storing configuration information in a configuration database for each consumer electronic media device coupled to said network.

7. The method as recited in claim 1 further comprising the steps of:

storing resource reservation information into a reservation database;

provided said media service is to be delivered in a later time, reserving said source consumer electronic media device, said destination consumer electronic media device and said routing path by adding an entry to said reservation database; and

informing said network that said media service is unavailable at said later time.

8. A computer-usable medium having computer-readable program code embodied therein for causing a computer system to perform a method of managing resources within a network including a plurality of consumer electronic media devices, said method comprising the steps of:

a) providing a resource manager for managing resources within said method;

b) receiving a request for a media service, said request identifying a source consumer electronic media device and a destination consumer electronic media device that are necessary for performing said media service;

c) based on said request, said resource manager determining whether said source consumer electronic media device and said destination consumer electronic device are available for performing said media service;

d) said resource manager determining whether a routing path between said source and said destination consumer electronic media devices has sufficient bandwidth for performing said media service; and

e) provided said plurality of electronic media devices are available and provided said routing path has sufficient bandwidth, said resource manager transmitting control signals to cause said plurality of consumer electronic media devices to provide said media service.

9. The computer-usable medium as recited in claim 8 wherein said method further comprises the step of returning a failure message provided said routing path does not have sufficient bandwidth for performing said media service.

10. The computer-usable medium as recited in claim 8 wherein said method further comprises the steps of:

constructing a list having a plurality of entries each corresponding to a respective one of said consumer electronic media devices coupled to said network;

removing one of said entries from said list when a corresponding one of said plurality of consumer electronic media devices becomes unavailable; and

adding a new entry to said list when one of said plurality of consumer electronic media devices becomes available.

11. The computer-usable medium as recited in claim 8 wherein said method further comprises the steps of:

constructing a list having a plurality of entries each corresponding to a respective one of a plurality of routing paths connecting consumer electronic media devices of said network;

determining bandwidth requirements for said routing paths of said network and generating data representative thereof; and

storing said data into a path database.

12. The computer-usable medium as recited in claim 11 wherein said method further comprises the steps of:

removing one of said entries from said list when a corresponding one of said plurality of routing paths becomes unavailable; and

adding a new entry to said list when said corresponding routing path becomes available.

13. The computer-usable medium as recited in claim 8 wherein said method further comprises the step storing configuration information into a configuration database for each consumer electronic media device coupled to said network.

14. The computer-usable medium as recited in claim 8 wherein said method further comprises the steps of:

storing resource reservation information into a reservation database;

provided said media service is to be delivered in a later time, reserving said source consumer electronic media device, said destination consumer electronic media device and said routing path by adding an entry to said reservation database; and

informing said network that said media service is unavailable at said later time.

15. A home server comprising:

a processor;

a bus coupled to said processor; and

a computer readable memory coupled to said bus and having stored therein computer readable program code for causing said home server to perform a method of managing resources within a network including a plurality of consumer electronic media devices, said home server, said method comprising the steps of:

a) providing a resource manager for managing resources of said network;

b) receiving a request for a media service, said request identifying a source consumer electronic media device

and a destination consumer electronic media device coupled to said network that are necessary for performing said media service;

c) based on said request, said resource manager determining whether said source consumer electronic media device and said destination consumer electronic device are available for performing said media service;

d) said resource manager determining whether a routing path between said source and said destination consumer electronic media devices has sufficient bandwidth for performing said media service; and

e) provided said plurality of electronic media devices are available and provided said routing path has sufficient bandwidth, said resource manager transmitting control signals to cause said plurality of consumer electronic media devices to provide said media service.

16. The home server as recited in claim **15** wherein said method further comprises the step of returning a failure message provided said routing path does not have sufficient bandwidth for performing said media service.

17. The home server as recited in claim **15** wherein said method further comprises the steps of:

constructing a list having a plurality of entries each corresponding to a respective one of consumer electronic media devices coupled to said network;

removing one of said entries from said list when a corresponding one of said plurality of consumer electronic media devices becomes unavailable; and

adding a new entry to said list when one of said plurality of consumer electronic media devices becomes available.

18. The home server as recited in claim **15** wherein said method further comprises the steps of:

constructing a list having a plurality of entries each corresponding to a respective one of a plurality of routing paths connecting consumer electronic media devices of said network;

determining bandwidth requirements for said routing paths of said network and generating data representative thereof; and

storing said data in a path database.

19. The home server as recited in claim **18** wherein said method further comprises the steps of:

removing one of said entries from said list when a corresponding one of said plurality of routing paths becomes unavailable; and

adding a new entry to said list when said corresponding routing path is becomes available.

20. The home server as recited in claim **15** wherein said method further comprises the step of storing configuration information into a configuration database for each consumer electronic media device coupled to said network.

21. The home server as recited in claim **15** wherein said method further comprises the steps of:

storing resource reservation information into a reservation database;

provided said media service is to be delivered in a later time, reserving said source consumer electronic media device, said destination consumer electronic media device and said routing path by adding an entry to said reservation database; and

informing said network that said media service is unavailable at said later time.

* * * * *

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Eytchison (43) Pub. Date: Nov. 29, 2001

(54) HAVI-VHN BRIDGE SOLUTION

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(22) Filed: Feb. 8, 2001

Related U.S. Application Data

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Publication Classification

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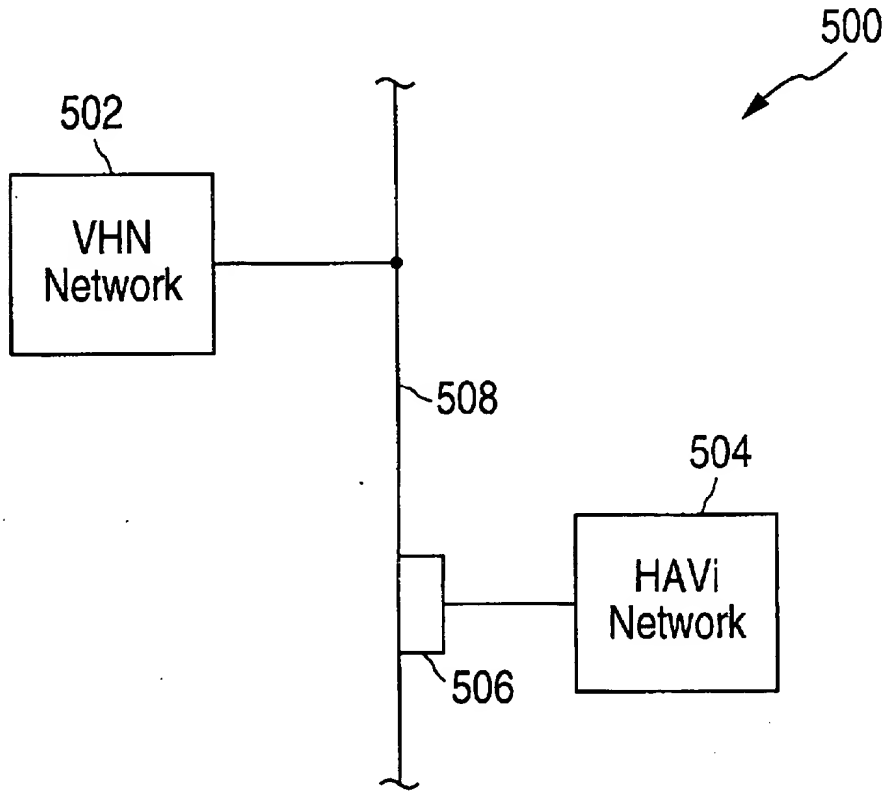
(52) U.S. Cl. 709/249; 709/246

(57) ABSTRACT

Interoperability is facilitated between two networks. One method according to the present invention comprises: providing a VHN network having a VHN element; providing a HAVi network having a HAVi element; translating messages via a protocol translator coupled with the VHN network and the HAVi network; wherein interoperability is facilitated between the HAVi element and the VHN element.



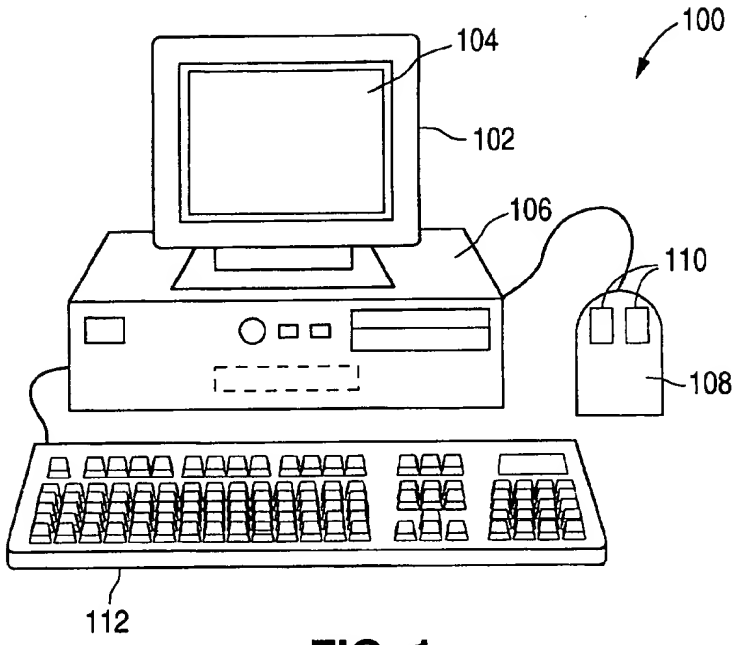

100
104
102
106
110
108
112

FIG. 1

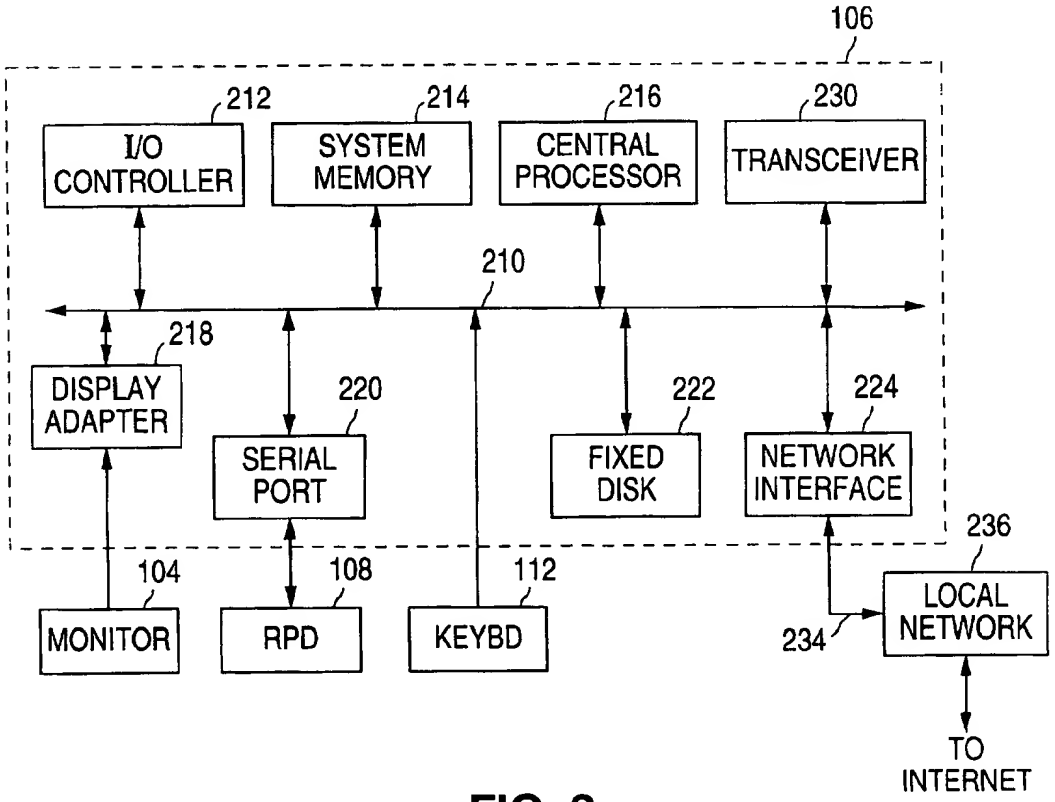

106
212
214
216
230
I/O CONTROLLER
SYSTEM MEMORY
CENTRAL PROCESSOR
TRANSCEIVER
210
218
DISPLAY ADAPTER
220
SERIAL PORT
222
FIXED DISK
224
NETWORK INTERFACE
236
104
108
112
MONITOR
RPD
KEYBD
234
LOCAL NETWORK
TO INTERNET

FIG. 2

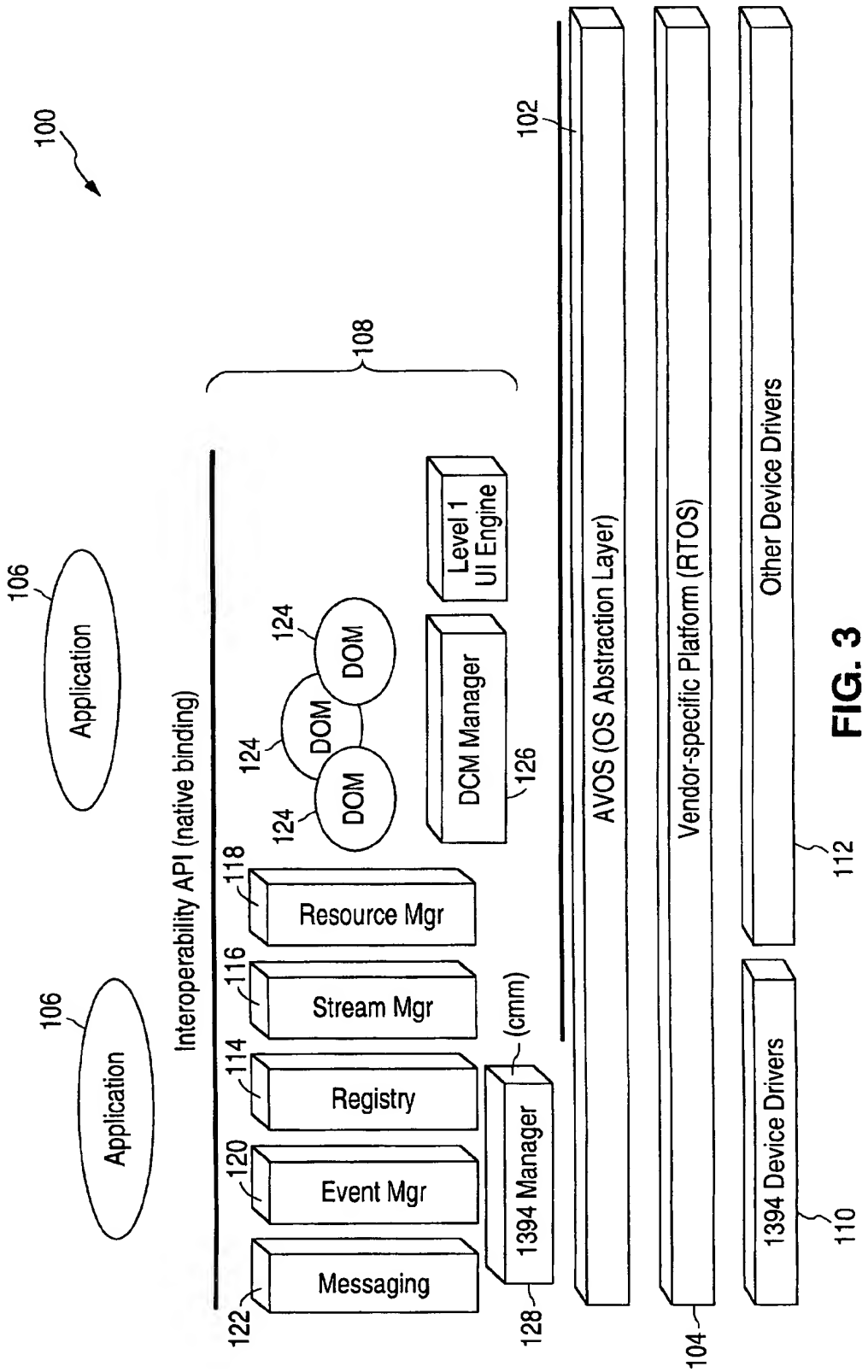

100
102
108
106
Application
106
Application
Interoperability API (native binding)
124
DOM
124
DOM
124
DOM
Level 1
UI Engine
DCM Manager
126
118
Resource Mgr
116
Stream Mgr
114
Registry
120
Event Mgr
Messaging
122
(cmm)
1394 Manager
128
AVOS (OS Abstraction Layer)
Vendor-specific Platform (RTOS)
104
Other Device Drivers
112
1394 Device Drivers
110

FIG. 3

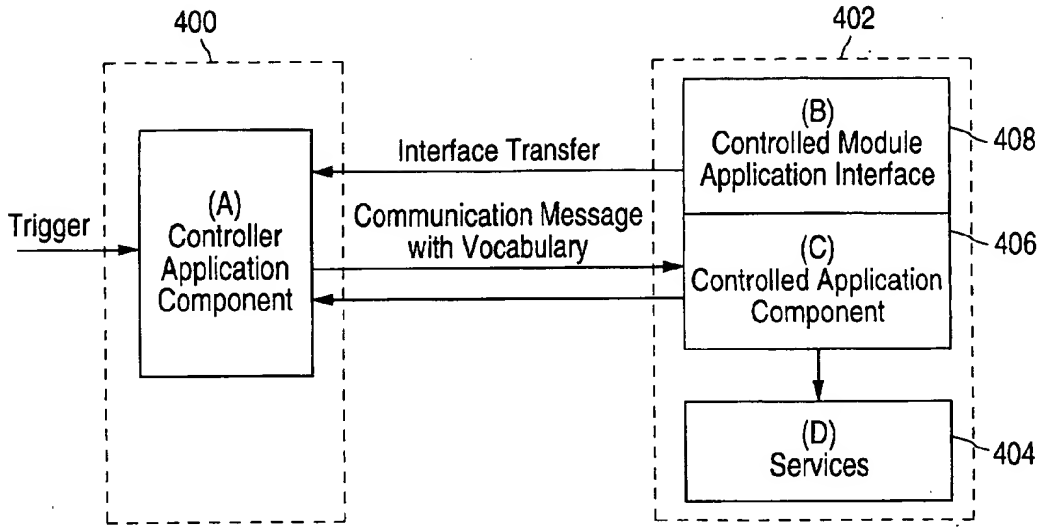

400
402
(B)
Controlled Module
Application Interface
408
Interface Transfer
Trigger
(A)
Controller
Application
Component
Communication Message
with Vocabulary
(C)
Controlled Application
Component
406
(D)
Services
404

FIG. 4

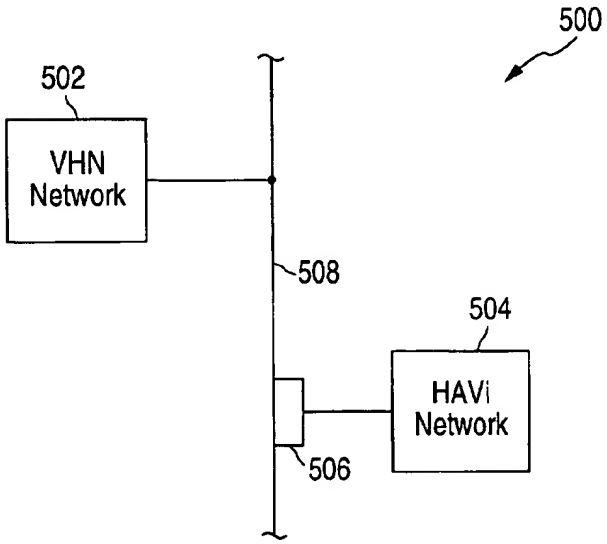

500
502
VHN
Network
508
504
HAVi
Network
506

FIG. 5

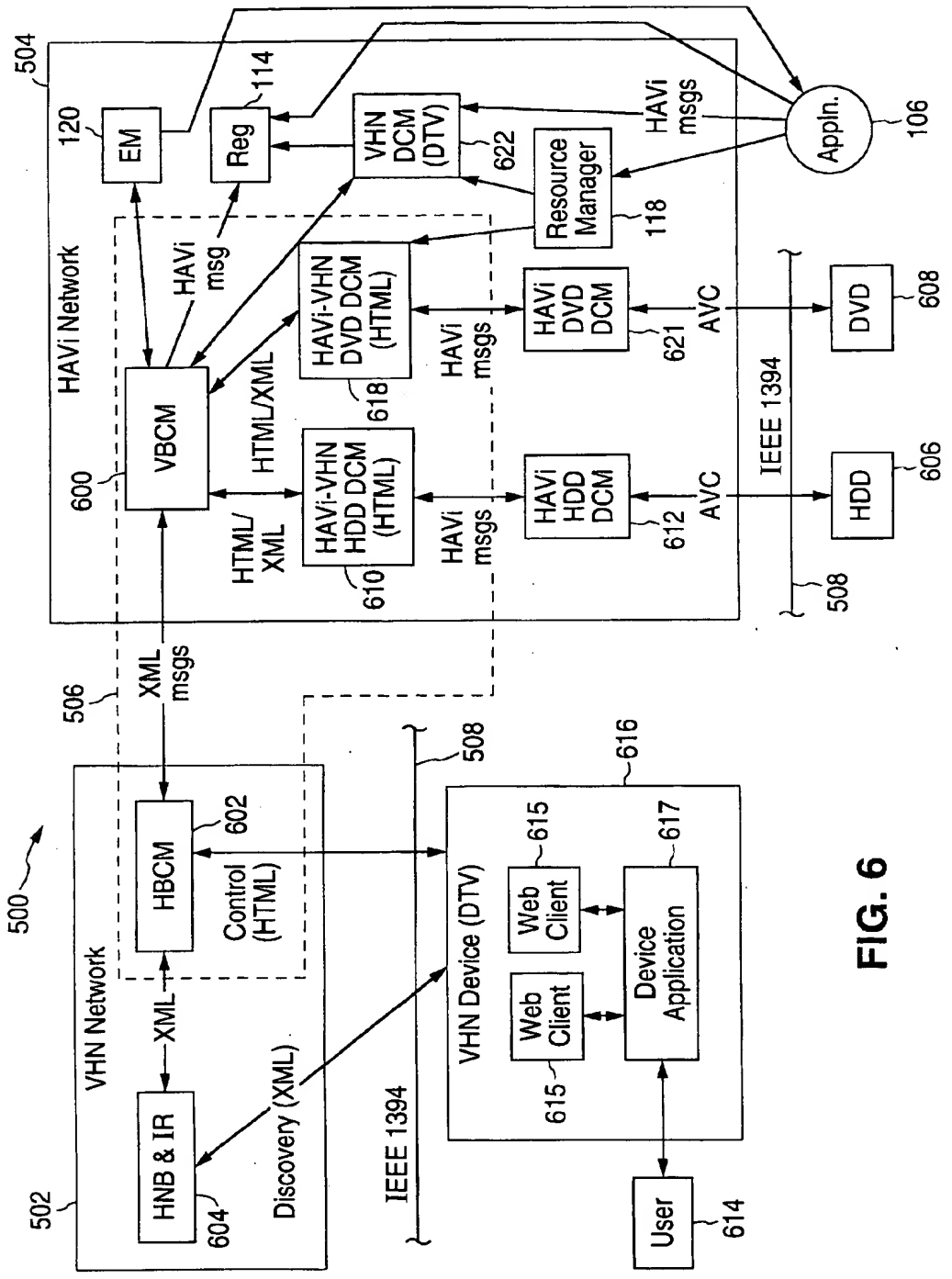

500
502
504
506
508
600
604
606
608
610
612
614
615
616
617
618
621
622
120
114
106
118
HAVi Network
VHN Network
VHN Device (DTV)
VBCM
HBCM
HNB & IR
EM
Reg
Appln.
Resource Manager
VHN DCM (DTV)
HAVi-VHN DVD DCM (HTML)
HAVi-VHN HDD DCM (HTML)
HAVi DVD DCM
HAVi HDD DCM
DVD
HDD
Web Client
Web Client
Device Application
User
Control (HTML)
HAVi msg
HAVi msgs
HTML/XML
HTML/ XML
XML msgs
XML
Discovery (XML)
IEEE 1394
IEEE 1394
AVC
AVC

FIG. 6

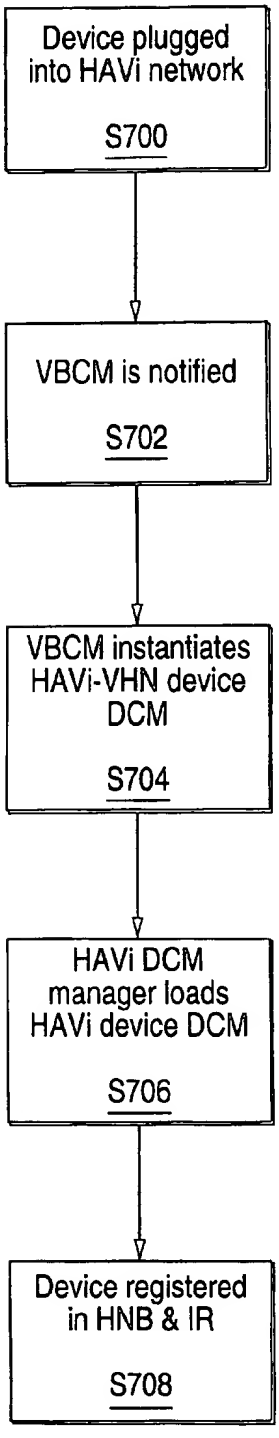

Device plugged into HAVi network
S700
VBCM is notified
S702
VBCM instantiates HAVi-VHN device DCM
S704
HAVi DCM manager loads HAVi device DCM
S706
Device registered in HNB & IR
S708

FIG. 7

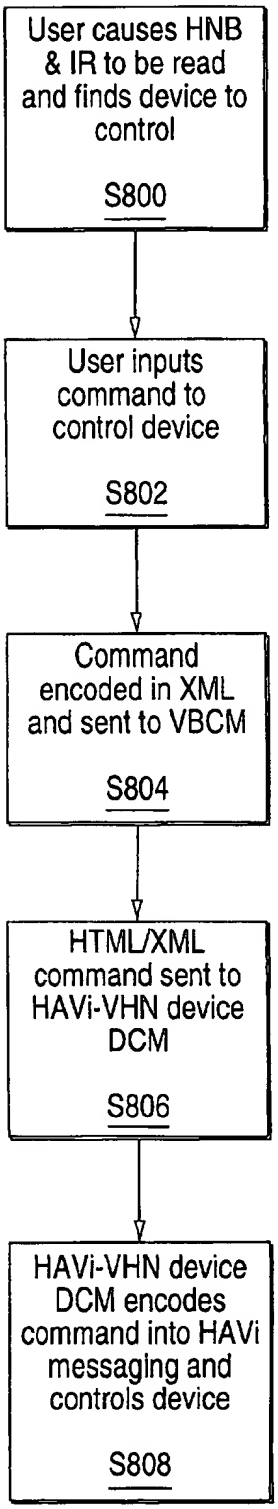

User causes HNB & IR to be read and finds device to control
S800
User inputs command to control device
S802
Command encoded in XML and sent to VBCM
S804
HTML/XML command sent to HAVi-VHN device DCM
S806
HAVi-VHN device DCM encodes command into HAVi messaging and controls device
S808

FIG. 8

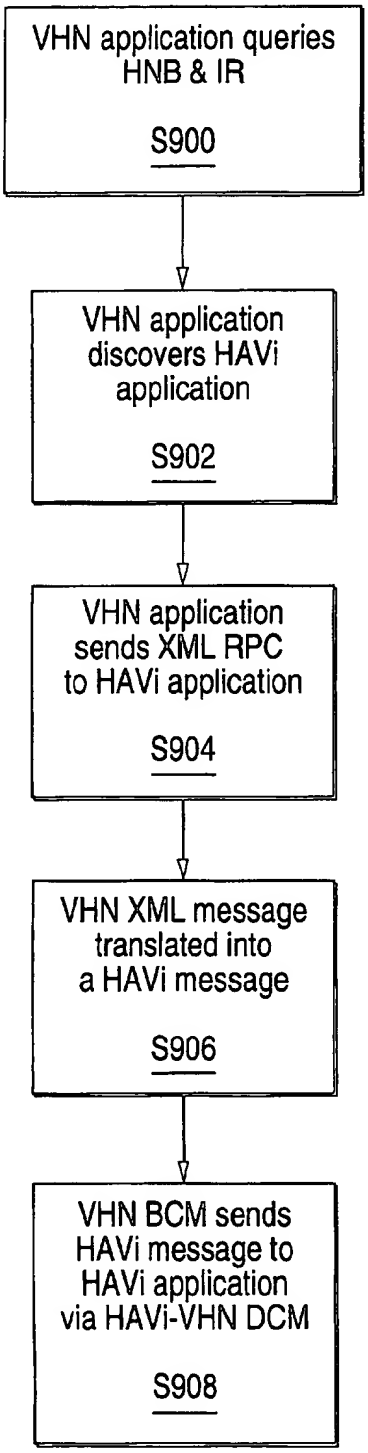

VHN application queries HNB & IR
S900
VHN application discovers HAVi application
S902
VHN application sends XML RPC to HAVi application
S904
VHN XML message translated into a HAVi message
S906
VHN BCM sends HAVi message to HAVi application via HAVi-VHN DCM
S908

FIG. 9

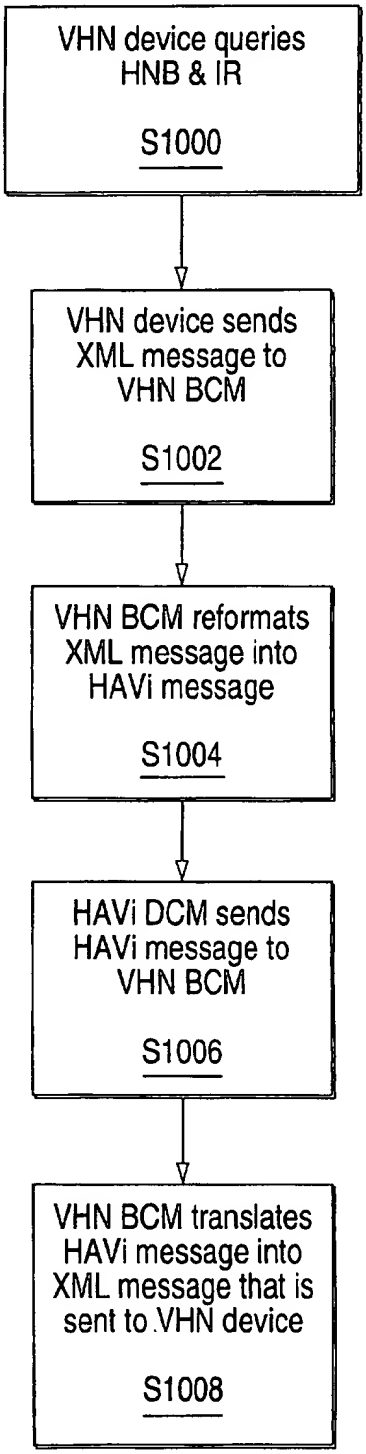

VHN device queries HNB & IR
S1000
VHN device sends XML message to VHN BCM
S1002
VHN BCM reformats XML message into HAVi message
S1004
HAVi DCM sends HAVi message to VHN BCM
S1006
VHN BCM translates HAVi message into XML message that is sent to VHN device
S1008

FIG. 10

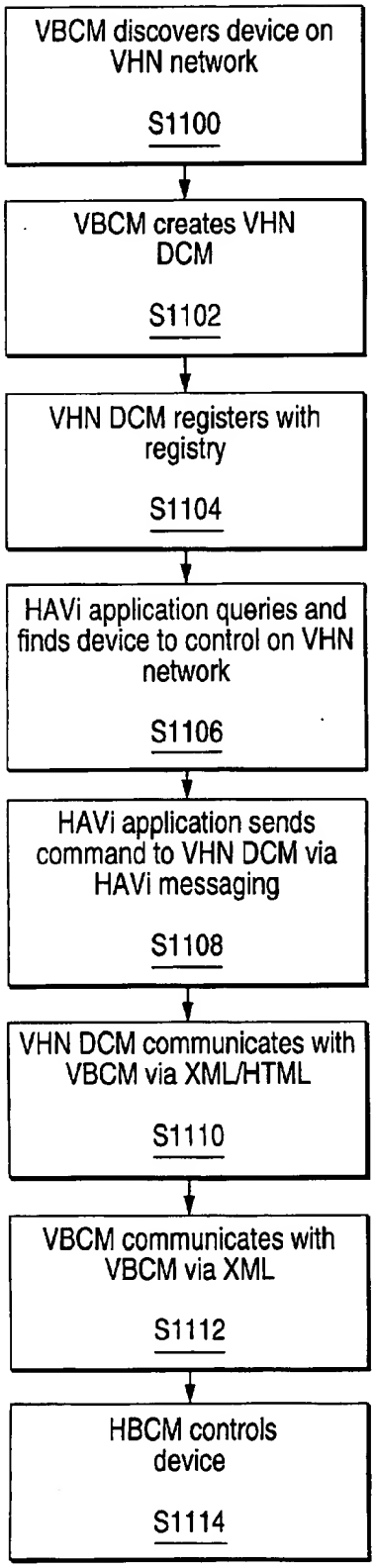

VBCM discovers device on VHN network
S1100
VBCM creates VHN DCM
S1102
VHN DCM registers with registry
S1104
HAVi application queries and finds device to control on VHN network
S1106
HAVi application sends command to VHN DCM via HAVi messaging
S1108
VHN DCM communicates with VBCM via XML/HTML
S1110
VBCM communicates with VBCM via XML
S1112
HBCM controls device
S1114

FIG. 11

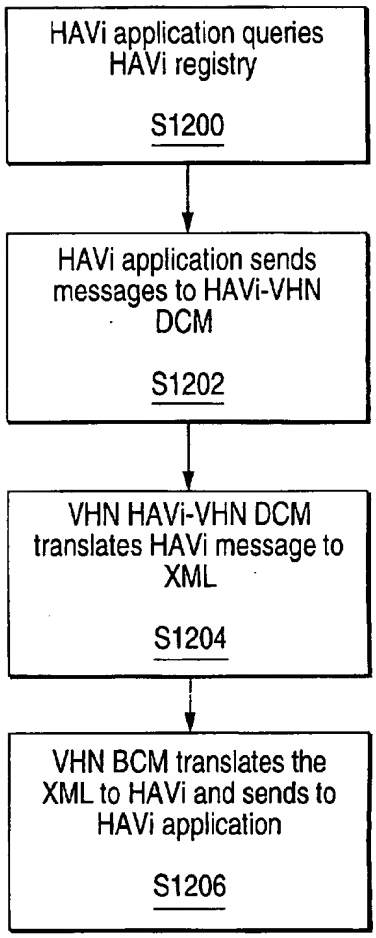

HAVi application queries HAVi registry
S1200
HAVi application sends messages to HAVi-VHN DCM
S1202
VHN HAVi-VHN DCM translates HAVi message to XML
S1204
VHN BCM translates the XML to HAVi and sends to HAVi application
S1206

FIG. 12

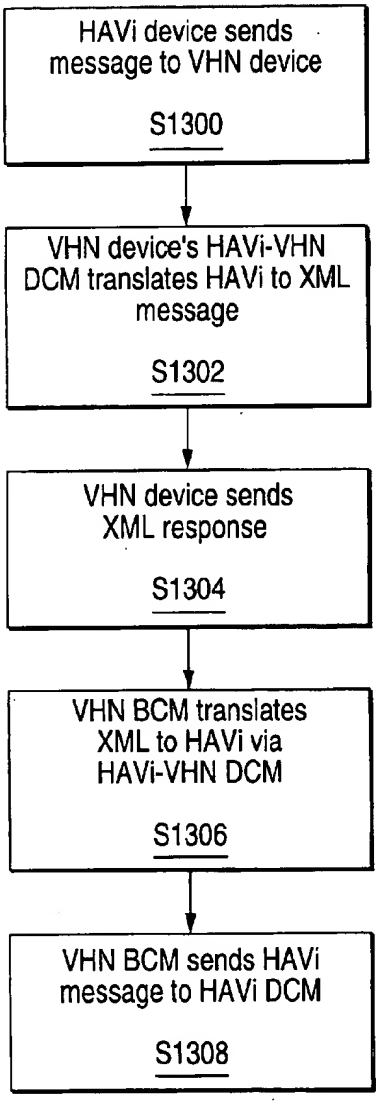

HAVi device sends message to VHN device
S1300
VHN device's HAVi-VHN DCM translates HAVi to XML message
S1302
VHN device sends XML response
S1304
VHN BCM translates XML to HAVi via HAVi-VHN DCM
S1306
VHN BCM sends HAVi message to HAVi DCM
S1308

FIG. 13

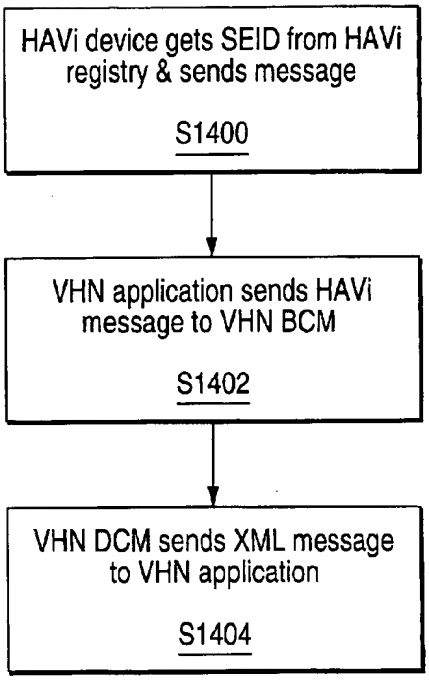

HAVi device gets SEID from HAVi registry & sends message
S1400
VHN application sends HAVi message to VHN BCM
S1402
VHN DCM sends XML message to VHN application
S1404

FIG. 14

HAVI-VHN BRIDGE SOLUTION

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This invention derives priority from U.S. Provisional Patent Application No. 60/181,406, filed Feb. 9, 2000 and entitled "HAVi-VHN Bridge Solution," which is incorporated herein in its entirety for all purposes.

BACKGROUND OF THE INVENTION

[0002] A typical home audio/video (AV) equipment set-up includes a number of components. For example, a radio receiver, a compact disc (CD) player, a pair of speakers, a television (TV), a video cassette recorder (VCR), a tape deck and the like. Each of these components are connected to each other via a set of wires. One component is usually the central component of the home AV system. This is usually the radio receiver or the tuner of the radio receiver. The tuner has a number of specific inputs for coupling the other components. The tuner has a corresponding number of control buttons or control switches which provide a limited degree of controllability and interoperability for the components. The control buttons and control switches are usually located on the front of the tuner. In many cases, some or all of these buttons and switches are duplicated on a hand-held remote control unit. A user controls the home AV system by manipulating the buttons and switches on the front of the tuner, or alternatively, manipulating buttons on the hand-held remote control unit.

[0003] This conventional home AV system paradigm has become quite popular. As consumer electronic (CE) devices become more capable and more complex, the demand for the latest and most capable devices has increased. As new devices emerge and become popular, the devices are purchased by consumers and "plugged" into their home AV systems. Generally, the latest and most sophisticated of these devices are quite expensive (e.g., digital audio tape recorders, digital video disc (DVD) players, digital camcorders and the like). As a consumer purchases new devices, most often, the new device is simply plugged into the system alongside the pre-existing, older devices (e.g., cassette tape deck, CD player and the like). The new device is plugged into an open input on the back of the tuner, or some other device coupled with the tuner. The consumer (e.g., the user) controls the new device via the control buttons on the tuner, via the control buttons and control switches on the front of the new device itself, or via an entirely new, separate, respective remote control unit for the new device.

[0004] As the number of new CE devices for the home AV system has grown and as the sophistication and capabilities of these devices have increased, a number of problems with the conventional paradigm have emerged. One such problem is incompatibility between devices in the home AV system. CE devices from one manufacturer often couple with an AV system in a different manner than similar devices from another manufacturer. For example, a tuner made by one manufacturer may not properly couple with a TV made by another manufacturer.

[0005] In addition, where one device is much newer than another device additional incompatibilities may exist. For example, a new device might incorporate hardware (e.g., specific inputs and outputs) which enables more sophisticated remote control functions. This hardware may be unusable with older devices within the system. As another example, older tuners may lack suitable inputs for some newer devices (e.g., mini-disc players, VCR's, etc.), or may lack enough inputs for all devices of the system.

[0006] Another problem is the lack of functional support for differing devices within the home AV system. For example, even though a TV may support advanced sound formats (e.g., surround sound, stereo, etc.), if an older less capable tuner does not support such functionality, the benefits of the advanced sound formats can be lost.

[0007] Yet another problem is the proliferation of controls for the new and differing devices within the home AV system. For example, similar devices from different manufacturers can each have different control buttons and control switch formats for accomplishing similar tasks (e.g., setting the clock on a VCR, programming a VCR to record a program, and the like). In addition, each new device coupled with the AV system often leads to another dedicated remote control unit for the user to keep track of and learn to operate.

[0008] Standards have been developed for the home AV system which aim to correct the interoperability and functionality problems of the conventional system. These standards include the Home Audio/Video Interoperability (HAVi) Architecture and the Video Electronics Standards Association (VESA) Home Network, or VHN.

SUMMARY OF THE INVENTION

[0009] In an embodiment of a method according to the present invention, interoperability is facilitated between two networks. The method comprises: providing a VHN network having a VHN element; providing a HAVi network having a HAVi element; translating messages via a protocol translator coupled with the VHN network and the HAVi network; wherein interoperability is facilitated between the HAVi element and the VHN element

[0010] In an embodiment of a method according to the present invention, interoperability is facilitated between two networks. The method comprises: providing a VHN network having a VHN element; providing a HAVi network having a HAVi element; providing a protocol translator coupled with the VHN network and the HAVi network; and controlling the at least one VHN element with the at least one HAVi element.

[0011] In an embodiment of a computer-readable media according to the present invention, interoperability is facilitated between a VHN network having a VHN element and a HAVi network having a HAVi element. The computer-readable media comprises: providing instructions for coupling the VHN network with the HAVi network; and providing instructions for facilitating interoperability between the HAVi element and the VHN element.

[0012] In an embodiment of a system according to the present invention, interoperability is facilitated between two networks. The system comprises: a VHN network having a VHN element; a HAVi network having a HAVi element; and a protocol translator coupled with the VHN network and the HAVi network; wherein the protocol translator facilitates interoperability between the HAVi element and the VHN element.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] **FIG. 1** is an illustration of a computer system suitable for use with the present invention.

[0014] **FIG. 2** shows subsystems in the computer system of **FIG. 1**.

[0015] **FIG. 3** depicts the arrangement of software elements on a HAVi FAV device.

[0016] **FIG. 4** is a basic VHN device-to-device control model.

[0017] **FIG. 5** illustrates a VHN network coupled with a HAVi network.

[0018] **FIG. 6** illustrates **FIG. 5** in greater detail.

[0019] **FIG. 7** is a flow diagram of a new device being plugged into a HAVi network.

[0020] **FIG. 8** is a flow diagram of a VHN application controlling a HAVi device.

[0021] **FIG. 9** is a flow diagram of a VHN application controlling a HAVi application.

[0022] **FIG. 10** is a flow diagram of a VHN device controlling a HAVi device. **FIG. 10** is also a flow diagram of a VHN device controlling a HAVi application.

[0023] **FIG. 11** is a flow diagram of a HAVi application controlling a VHN device.

[0024] **FIG. 12** is a flow diagram of a HAVi application controlling a VHN application.

[0025] **FIG. 13** is a flow diagram of a HAVi device controlling a VHN device.

[0026] **FIG. 14** is a flow diagram of a HAVi device controlling a VHN application.

DESCRIPTION OF THE SPECIFIC EMBODIMENTS

[0027] As shown in the exemplary drawings wherein like reference numerals indicate like or corresponding elements among the figures, an embodiment of a system according to the present invention will now be described in detail. The description describes an exemplary apparatus suitable to implement an embodiment of the present invention. Methods of operation and associated user interface details in accordance with the invention are also provided.

[0028] **FIG. 1** shows a computer system **100** suitable for use to provide a system in accordance with the present invention. The computer system **100** includes a display **102** having a display screen **104** (the display may be a digital television (DTV) or personal digital assistant (PDA)-like device, etc.). A cabinet **106** houses standard computer components (not shown) such as a disk drive, CD-ROM drive, display adapter, network card, random access memory (RAM), central processing unit (CPU) and other components, subsystems and devices (since these inventions talk about a home network, **106** may be a STB (set top box) and not a standard PC). User input devices such as a mouse **108** having buttons **110**, and a keyboard **112** are shown (another input device may be a two-way remote controller, a PDA-like device or a Sony Airboard device). Other user input devices such as a trackball, touch-screen, digitizing tablet, etc., can be used. In general, the computer system **100** is illustrative of one type of computer system, such as a desktop computer, suitable for use with the present invention. Computers can be configured with many different hardware components and can be made in many dimensions and styles (e.g., laptop, palmtop, server, workstation and mainframe). Thus, any hardware platform suitable for performing the processing described herein is suitable for use with the present invention.

[0029] **FIG. 2** illustrates subsystems found in the computer system **100**. Subsystems within box **106** are directly interfaced to an internal bus **210**. The subsystems include input/output (I/O) controller **212**, system random access memory (RAM) **214**, central processing unit (CPU) **216**, display adapter **218**, serial port **220**, fixed disk **222**, network interface adapter **224** and transceiver **230**. The use of the bus allows each of the subsystems to transfer data among the subsystems and, most importantly, with the CPU. External devices can communicate with the CPU or other subsystems via the bus by interfacing with a subsystem on the bus. The monitor **104** connects to the bus through the display adapter **218**. A relative pointing device (RPD) such as a mouse **108** connects through the serial port. Some devices such as keyboard **112** can communicate with the CPU by direct means without using the main data bus as, for example, via an interrupt controller and associated registers (not shown). The transceiver **230** can be coupled with a satellite system, cable system, telephone lines or any other system suitable for propagating information. The transceiver can include or be coupled with a communication interface, which can be coupled with bus **210**.

[0030] **FIG. 2** is illustrative of one suitable configuration for providing a system in accordance with the present invention. Subsystems, components or devices other than those shown in **FIG. 2** can be added without deviating from the scope of the invention. A suitable computer system can also be achieved without using all of the subsystems shown in **FIG. 2**. Other subsystems such as a CD-ROM drive, graphics accelerator, etc., can be included in the configuration without affecting the performance of the system included in the present invention.

[0031] The invention is related to the use of apparatus, such as the computer system **100**, for implementing a scalable pay-by-time technique for the secure multicast distribution of streaming content, including, but not limited to, video and audio. According to one embodiment of the invention, multicast distribution is provided by the computer system **100** in response to the processor **216** executing one or more sequences of one or more instructions contained in the system memory **214**. Such instructions may be read into memory **214** from a computer-readable medium, such as a fixed disk **222**. Execution of the sequences of instructions contained in the memory **214** causes the processor to perform the process steps described herein. One or more processors in a multi-processing arrangement may also be employed to execute the sequences of instructions contained in the memory. In alternative embodiments, hard-wired circuitry may be used in place of or in combination with software instructions to implement the invention. Thus, embodiments of the invention are not limited to any specific combination of hardware circuitry and software.

[0032] The terms "computer-readable medium" and "computer-readable media" as used herein refer to any

medium or media that participate in providing instructions to the processor **214** for execution. Such media can take many forms, including, but not limited to, non-volatile media, volatile media and transmission media. Non-volatile media include, for example, optical or magnetic disks, such as a fixed disk **222**. Volatile media include dynamic memory, such as memory **214**. Transmission media include coaxial cables, copper wire and fiber optics, including the wires that comprise the bus **210**. Transmission media can also take the form of acoustic or light waves, such as those generated during radio frequency (RF) and infra-red (IR) data communications. Common forms of computer-readable media include, for example, a floppy disk, a flexible disk, a hard disk, magnetic tape, any other magnetic medium, a CD-ROM disk, DVD, any other optical medium, punch cards, paper tape, any other physical medium with patterns of holes, a RAM, a PROM, an EPROM, a FLASH-EPROM, any other memory chip or cartridge, a carrier wave as described hereinafter, or any other medium from which a computer can read.

[0033] Various forms of computer-readable media may be involved in carrying one or more sequences of one or more instructions to processor **216** for execution. For example, the instructions may initially be borne on a magnetic disk of a remote computer. The remote computer can load the instructions into its dynamic memory and send the instructions over a telephone line using a modem. A modem local to the computer system **100** can receive the data on the telephone line and use an infrared transmitter to convert the data to an infrared signal. An infrared detector coupled with the bus **210** can receive the data carried in the infrared signal and place the data on the bus. The bus carries the data to the memory **214**, from which the processor retrieves and executes the instructions. The instructions received by the memory can optionally be stored on the fixed disk **222** either before or after execution by the processor.

[0034] The computer system **100** also includes a network interface **224** or communication interface coupled to the bus **210**. The network interface or communication interface provides a two-way data communication coupling with a network link **234** that is connected to a local network **236**. For example, the network interface or communication interface can be an integrated services digital network (ISDN) card or a modem to provide a data communication connection to a corresponding type of telephone line. As another example, the network interface or communication interface can be a local area network (LAN) card to provide a data communication connection to a compatible LAN. Wireless links can also be implemented. In any such implementation, the network interface **224** or the communication interface and transceiver **230**) send and receives electrical, electromagnetic or optical signals that carry digital data streams representing various types of information.

[0035] The network link **234** typically provides data communication through one or more networks to other data devices. For example, the network link can provide a connection through the local network **236** to a host computer or to data equipment operated by an Internet Service Provider (ISP). The ISP in turn provides data communication services through the worldwide packet data communication network, now commonly referred to as the "Internet." The local network and the Internet both use electrical, electromagnetic or optical signals that carry digital data streams. The signals that propagate through the various networks and the signals on the network link and that propagate through the network interface **224**, and the signals that propagate through the transceiver **230**, which carry the digital data to and from computer system **100**, are exemplary forms of carrier waves transporting the information.

[0036] The computer system **100** can send messages and receive data, including user commands, video data, audio data and program codes through the network(s), the network link **234**, and the network interface **224**. In the Internet example, a server might transmit a requested code for an application program through the ISP, Internet, local network **236** and network interface **224**. Instead of or in addition to transmission via the Internet, the computer system **100** can send and receive data via the transceiver **230** and a wireless system, satellite system, cable system, telephone lines or any other system suitable for propagating information between the computer system and an information distribution system. In accordance with the invention, one such downloaded application provides for a scalable pay-by-time technique for secure multicast distribution of streaming content as described herein. The processor **216** can execute the received code as the code is received, and/or store the code on the fixed disk **222**, or other non-volatile storage for later execution. In this manner, the computer system can obtain an application code in the form of a carrier wave.

[0037] It is contemplated that various hardware components can be added to the present system. Some examples of these components include set-top boxes, interactive televisions and mobile devices.

[0038] Unless specifically stated otherwise or apparent from the following discussion, one should appreciate that terms such as "computer,""compute,""computed,""computing,""processor,""process,""processed""processing, ""memory" or the like, can refer to the parts, actions and processes of an intelligent device such as a computer system, set-top box, digital television or the like. Moreover, the computer system **100** can refer to any CE device that provides a computer system platform. Some examples of such CE devices include set-top boxes (STB's), DTV's, general purpose home control devices and personal computers (PC's), which are known in the art.

[0039] The HAVi architecture, mentioned above, is intended for implementation on computing devices and CE devices. HAVi, which is known in the art, provides a set of services which facilitate interoperability and the development of distributed applications on home networks. HAVi is a software architecture that allows new devices to be integrated into the home network and to offer their services in an open and seamless manner. The types of devices supported by HAVi include, but are not limited to: DTV, set-top box, DVD, tuner, VCR, clock, camera, AV disc, display, amplifier, modem, Web proxy and converter. HAVi devices are Institute of Electrical and Electronics Engineers (IEEE) 1394 enabled.

[0040] Referring to **FIG. 3**, the arrangement of software elements **100** on a HAVi Full AV (FAV) Device is depicted. Collectively, these software elements expose the Interoperability Application Programming Interface (API), a set of services for building portable distributed applications on the home network. The following is a general description of the HAVi Architecture. The Audio/Video Operating System

(AVOS) **102** is a portability layer on top of the vendor-specific platform **104** (e.g., RTOS or Windows CE). The AVOS acts as a portability layer by allowing a change of vendor platform without the need to rewrite the upper layer applications **106** and middleware **108**. Below the vendor-specific platform lie the 1394 device drivers **110** and other device drivers **112**.

[0041] When an application in a HAVi environment wants to find out about what kind of network devices or network services are available, the application goes to the registry **114**. Software elements describe themselves to the registry. Applications can go to the registry to find out what those software elements are. It is a way to implement discovery. The stream manager **116** is responsible for setting up streams of data. For example, the stream manager may stream video from a hard disc drive to a TV.

[0042] The resource manager **118** is responsible for scheduling resources. For example, tells devices when to turn on or off, or to play loudly or softly. Basically, the function of a resource manager is analogous to that of a conductor of a symphony. The event manager **120** acts as an event mechanism. An application may be interested in when an asynchronous event occurs. The event manager generates an event at appropriate times (e.g., when a TV turns on or off).

[0043] The messaging system **122** is a conduit for messages to be passed through. The messaging system communicates with the event manager **120**, the stream manager **116** and device control modules (DCM's) **124**. DCM's are conceptually central to the HAVi architecture and the source of flexibility in accommodating new features and devices. DCM's act as software proxies. There is one DCM present in a HAVi system per device. In order to communicate with a given device, an application or other device communicates with the DCM, which in turn communicates with the given device using the appropriate protocol proprietary to the given device.

[0044] The DCM manager **126** is responsible for loading, instantiating and removing DCM's **124** from the system. The DCM manager oversees the installation and removal of DCM's. For, example, if a system included a TV, a hard drive and two set-top boxes, the DCM manager would determine on which the devices the various DCM's would run. The DCM manager would load the byte code from the configuration ROM of the BAV devices and create DCM's within one or both of the set-top boxes. There would only be one DCM created per device that is going to be controlled. The DCM manager oversees the DCM installation and makes sure that only one DCM is running per device that is going to be controlled. The DCM manager decides which FAV or IAV device stores each DCM.

[0045] Intermediate AV devices (IAV's) and Base AV devices (BAV's) are also part of a typical HAVi system. IAV devices are generally lower in cost than FAV devices and more limited in resources. IAV devices do not provide a runtime environment for Java bytecode and so cannot act as controllers for arbitrary devices within the home network. However, an IAV may provide native support for control of particular devices on the home network.

[0046] A BAV device is a "dumb" device (e.g., a printer) that provides uploadable Java bytecode, but does not host any of the software elements of the HAVi architecture. The control information for the BAV device is stored on configuration read-only memory (ROM) within the device. This information relates to how to control the BAV device and how it talks to other BAV devices can be controlled by an FAV device via the uploadable bytecode or from an IAV device via native code. The protocol between the BAV device and the BAV software proxy may or may not be proprietary. Communication between an FAV or IAV device and a BAV device requires that HAVi commands be translated to and from the command protocol used by the BAV device.

[0047] A device (e.g., TV, camera, set-top box, stereo system, MP3 player) can be controlled (e.g., turn on, turn off, play, fast-forward) by commands. Those commands can be in Java bytecode, which can live inside the configuration ROM of the device itself. The DCM manager **126** reads the byte code in the configuration ROM of a BAV device and creates the DCM for the BAV device. When an entity tells the DCM to, say, power on, the DCM tells the corresponding device to power on. The DCM sends a control sequence (a command packet) over an IEEE 1394 bus, wireless connection, etc.

[0048] The function of the 1394 communication media manager (CMM) **128** is to manage communications and put the bits on the wires. In use, when a CE device is plugged into the HAVi network, the network creates a bus reset and sends this signal on the 1394 bus to all devices on the bus. The CMM detects the bus reset and sends a new CE device event to the DCM manager **126**. This happens through the event manager **120**. Any device can register with the event manager and will subsequently be informed when a new device is on the bus. The CMM then reads the configuration ROM and retrieves a DCM code unit. The CMM causes the code unit to install the DCM **124**. Subsequently, the DCM **124** registers with the messaging system **122** and the registry **114**.

[0049] A HAVi application **106** that has initialized itself and is running registers with the messaging system **122** so that it can communicate with other processes. The event manager **120** notifies a HAVi application that is running of a new device on the bus. The HAVi application can go to the registry **114** to find out if there is a device that it wants to control (e.g., VCR, TV, etc.). Let us assume the application is looking for a VCR to control. The application may find the VCR and gets the software handle from the registry. The application is now able to communicate with the DCM for the VCR. The HAVi application module can talk to the resource manager **118** and give instructions to, for example, turn on the VCR at 10:00 p.m. and record.

[0050] Furthermore, the DCM manager **126** is notified by the event manager **120** that there is a new device on the bus. The DCM manager reads the profile in the configuration ROM and reads the self-describing data (SDD) to find out what the device is. The DCM manager decides on a DCM host for the DCM of the new device and then loads the DCM. The HAVi application **106** may do discovery and go into the registry **114** and discover the new DCM was loaded. The HAVi application may then decide to control the new device (e.g., set the clock on the device, the device being a VCR).

[0051] The VHN architecture, mentioned above, allows for the recognition and interoperability of multiple home

network devices. This interoperability enables consumers to access all their networked appliances through devices such as their PC or TV. VHN utilizes Internet technologies to seamlessly connect all home devices, while providing remote device control using any Web browser. Using Internet protocols, the VHN network provides the capability to couple different network technologies together under one completely supported system.

[0052] A graphical user interface (GUI) for a VHN system may consist of a plurality of icons displayed on a computer or TV screen. When a user selects an icon, the HTML pages are retrieved from the configuration ROM of the device in question. The HTML pages are displayed for the user. This allows the user to control the given device.

[0053] Referring to **FIG. 4**, a basic VHN device-to-device control model is shown. The figure shows a controller module **400** and a controlled module **402**. The controller module can discover the controlled module and control the services **404** of the controlled module. The controlled application component **406**, an embedded executable software in the controlled module, has direct control over the services. The controlled module application interface **408** describes the controllable services and interface of the controlled application component.

[0054] If a device-to-device control process is triggered, the controller module **400** will first attempt to discover the controlled module **402**. After the controller module has discovered the interface of the controlled module, it can send commands thereto. This generates an acknowledgment and/or machine action of the services **404**. VHN allows the use of Web technology (XML) for the message and interface formats. A home network broker and interface repository (HNB & IR) can be located in any third device, or in a separate, dedicated device. The HNB & IR is a software agent that helps one device discover other devices and what their commands are, among other things.

[0055] When a device first comes online it registers with the HNB & IR, revealing the type of device it is and the commands that the device supports. If the controller module **400** wants to control the controlled module **402**, the controller module first has to go through discovery. Therefore, the controller module reads the HNB & IR and discovers the controlled module (e.g., that of a VCR) and also the commands it needs to communicate with or control the VCR. The controller module obtains the handle (IP address) for the controlled module. The controller module can now talk to the VCR and send commands through an XML-based remote procedure call (RPC).

[0056] In accordance with embodiments of the present invention, **FIG. 5** illustrates a network **500** comprising a VHN network **502** and a HAVi network **504**. The VHN network and the HAVi network each comprise at least one element. The elements can include devices and application. Interoperability is facilitated between the VHN network and the HAVi network by providing a protocol translator **506** coupled with the VHN network and the HAVi network, all of which are coupled to an IEEE 1394 bus **508** or other suitable bus. The protocol translator **506** can physically or logically be on the some device as the HAVi controller **504**. The protocol translator, or bridge, allows for controlling a HAVi element (device or application) with a VHN element (device or application).

[0057] Turning now to **FIG. 6**, **FIG. 5** is shown in greater detail. A VHN bridge control manager (VBCM) **600**, does handshaking and protocol conversion between the HAVi and VHN networks. The HAVi bridge control manager (HBCM) **602**, talks to the HNB & IR **604** in behalf of the HAVi network. The HBCM **602** and the VBCM **600** together comprise the protocol translator **506**, converting HAVi messages into XML messages and converting XML messaging into HAVi messages (as well as other things). The HAVi-VHN DCM's **610**, **618** (described below) may or may not be considered a part of the protocol translator. The HNB & IR knows which devices are on the VHN network and the HAVi network providing the VBCM is fully operational. Likewise, the HAVi registry knows which devices are on the HAVi network and the VHN network providing the HBCM is fully operational. In order for this to happen it is up to individual VHN devices to inform the HNB & IR of its presence in the VHN network and individual HAVi devices to inform the HAVi registry of its presence in the HAVi network. Otherwise the HNB & IR and HAVi registry will not know when devices come, go and change state. The HBCM constantly monitors the HNB & IR for new VHN devices so that the HAVi network **504** can know when to instantiate the respective HAVi-VHN DCM and it can register the VHN device with the HAVi registry. If a VHN device is removed from the network, the HBCM will notify the VBCM which will in turn remove the respective HAVi-VHN DCM. This is done to free memory.

[0058] As shown in **FIG. 7**, when a new device, such as hard disc drive (HDD) **606** or DVD player **608**, comes on the HAVi network **504** (step **S700**), a bus reset is generated. At **S702**, the DCM manager loads the HAVi DCM, and the DCM instantiates itself. At **S704**, the DCM (and corresponding FCMs) registers with the HAVi messaging system and the registry **114**. At **S706**, the HAVi event manager **120** notifies the VBCM **600** of the event (the new DCM). At **S708**, the VBCM instantiates the HAVi-VHN device DCM and sends a message to the HBCM **602**. The HBCM configures the new HAVi device into the VHN network and returns an IP address to the VBCM (the IP address will be used to reference the HAVi device in the VHN network). The returning of the IP address signifies that the HBCM successful configured the HAVi device in the VHN network. The VBCM uses the IP address in the protocol conversion and passes it to the HAVi-VHN device DCM.

[0059] Turning to **FIG. 8**, at step **S800**, after a DVD **608** is connected, a user from the VHN network can access the HAVi DVD device. This discover occurs by accessing the HNB & IR **604**. Control of the DVD player is through the VHN application's Web browser **615** and accessing the VHN BCM, and the device application **617**. The Web client pulls the HTML page out and HAVi-VHN DCM, thereby allowing the user to control the DVD player. At step **S802**, the user selects a "play" icon on the DTV **616**. At step **S804**, the play command is encoded in XML and sent to the VBCM **600**. At step **S806**, the VBCM in turns sends an HTML/XML command to the respective HAVi-VHN DVD DCM **618**. HAVi does not know how to interpret XML or HTML as HAVi does not use these protocols. The HAVi-VHN DVD DCM **618** knows the HAVi protocols as well as the VHN protocols.

[0060] At step **S808**, the HAVi-VHN DVD DCM **618** encodes the XML commands from the VHN network into a

HAVi messages because the HAVi DVD DCM **621** only knows HAVi messaging. Therefore, the VHN protocol has been mapped into HAVi messaging that the HAVi DVD DCM understands. The DVD player can thus be controlled by the HAVi DVD DCM. Consequently, we have a VHN application on the VHN network **502** controlling a HAVi device.

HAVi Startup Process

[0061] Before a HAVi application or device can become "HAVi aware," it must go through the HAVi startup process. In part, this means the application or device registers with the HAVi messaging system to obtain a software element identification (SEID) which is a globally unique identification in the HAVi network. The SEID is used in the HAVi system to allow other HAVi or VHN processes to access the application or device. Next the application or device must describe itself to the HAVi registry **114**. Afterwards the application is free to use any HAVi services. This same process must be followed for VHN devices or applications that want to interface to the HAVi network. This means VHN processes wishing to operate in the HAVi network must obtain a valid SEID and register with the HAVi registry.

The VHN Bridge Control Manager (VBCM)

[0062] The main function of the VBCM **600** is to expose HAVi devices to the VHN network and VHN devices to the HAVi network **504**. When the VBCM first initializes, it registers with the HAVi event manager **120** and request that all events related to new/gone device/application. When the VBCM receives notice (an event) of new devices or applications (an asynchronous event), it queries the HAVi registry **114** to determine their services. When the VBCM finds a HAVi device or application it creates a HAVi-VHN DCM. The VBCM indirectly gets an IP address (using VHN's DHCP services) and assignes it to the HAVi-VHN DCM (getting the IP address is actually done by the HBCM). This is so the HAVi-VHN DCM's can send and receive XML messages to the VHN network. The HAVi-VHN DCM's may contain HTML pages to represent the devices' services. If so, the HTML pages can be downloaded from the World Wide Web (WWW) or contained in the devices configuration ROM, or from other resources (e.g., a diskette or memory card that ships with device, etc).

[0063] After a HAVi-VHN DCM is created, the VBCM sends an XML message to the HAVi BCM notifying it of a new HAVi device or application. The XML message to the HAVi BCM is descriptive information about the HAVi device or application (model, device type, device manufacturer, etc.) and a unique identifier (SEID). This information will be used by the HAVi BCM to register HAVi devices or applications in the VHN network. When the HAVi BCM successfully configures the HAVi device, it returns an IP address to the VBCM. The IP address is used to reference the HAVi device in the VHN network. Lastly, the VBCM passes the IP address to the HAVI-VHN DCM where it will be used to cross reference HAVi messages and XML messages. Without this process, HAVi devices or applications would not be discovered in a VHN network.

[0064] Likewise, when the new VHN devices or applications are detected by the HAVi BCM, the VBCM **600** will receive a message from the HBCM. It is the responsibility of the VBCM to register the VHN device or application with the HAVi messaging system and registry. In turn, a SEID value is generated for the VHN device or application. The SEID is used to register the VHN device or application with the HAVi registry **114**. The registry will be given sufficient information about the VHN device or application so that the VHN device or application can be discovered in a HAVi network.

[0065] Finally, a HAVi-VHN DCM is created for the VHN device or application. This is necessary for VHN devices or applications to communicate with HAVi devices and for HAVi devices (or application) to communicate with VHN device. The HAVi-VHN DCM will translate XML messages into HAVi messages and HAVi messages into XML messages. Without this process, VHN devices or applications would not be discovered in a HAVi network.

[0066] A final note about the VBCM that needs to be pointed out is that it must support all the VHN Internet protocols which make it possible to interface into the VHN network. This means it will support TCP/IP and Web protocols. It will use the IP over IEEE 1394 protocol to send and receive XML messages to/from the VHN network. Also, it will contain a web server that is able to send HTML pages to VHN processes. Likewise, it will contain a modified web browser that is able to receive HTML pages and translate them into HAVi messages, Java UI (AWT), or DDI objects. In some situation, it is possible the HAVi-VHN DCMs may contain these and other protocols. This will allow the DCM to interface directly with the VHN devices without the aid of the HBCM and VBCM. However, in order to keep the system light (use less memory) it is desirable to keep the VHN protocols in the VBCM and have the HAVI-VHN DCM's use the services of the VBCM as needed.

The HAVi Bridge Control Manager (HBCM)

[0067] When the HBCM **602** is notified of a new HAVi device (or application) by the VHN BCM, it creates an IP address for the device using an available DHCP server. A map between the IP address and the SEID are maintained by the HBCM and VBCM independently of one another. This is used to cross-reference a HAVi device when it is being referenced in the VHN network as well as a VHN device when it is being used in the HAVi network.

[0068] When the HAVi BCM is notified of a new HAVi application or device, it registers the information with the HNB & IR **604**. This means passing an XML message that contains the IP address (and possibly the SEID) and a description of the HAVi device or application to the HNB & IR. Some of the device or application descriptive information may contain basic information, such as the device model, device features and a user-configurable device name. Other device manufacture-specific information may be included with the device information (i.e., device features, device software version, etc.). Without this process, a HAVi device or application would not be discovered in a VHN network.

[0069] The HBCM **602** is responsible for notifying the HAVi system of VHN processes (new and gone). This is accomplished by the HAVi BCM's ability to detect IEEE 1394 bus resets that helps it detect new VHN devices. Once a bus reset is detected, the HAVi BCM queries the HNB & IR **604** to discover new/gone VHN devices. In some situations VHN devices will not operate on the IEEE 1394 networks. In this case the HAVi BCM cannot dynamically detect VHN devices (or applications), so it is must periodically poll the HNB & IR to discover new/gone devices. There may be special situations where the HAVi BCM has to interface into VHN Backbone Component Interface (BCI)

devices to obtain end device information or state conditions. These situations would occur when end device or BCI devices are unable to report to the HNB & IR.

[0070] Once the HAVi BCM discovers a new VHN device (either by the HNB & IR or a BCI device), it will send a XML message to the VHN BCM requesting the VHN devices be configured and registered in the HAVi system. This will result in the VHN BCM registering the VHN device with the HAVi messaging system and returning a HAVi SEID. Also, the VHN BCM will register the VHN device with the HAVi registry **114** and create a HAVi-VHN DCM. This will allow HAVi applications and devices to interface into the VHN network **502**. The HAVi-VHN DCM will communicate to the VHN network over XML and RPC. When the configuration process is successful, the VHN BCM will send the SEID of the VHN device to the HAVi BCM signifying the registration process was completed. Without this process, a VHN device or application would not be discovered or operate in a HAVi network.

[0071] In one embodiment, as shown in **FIG. 9**, a VHN application can control a HAVi application. The VHN application queries the HNB & IR **604** to discover a HAVi application **106**, at **S900** and **S902**. The HNB & IR will return the IP address (and possible the SEID) of the HAVi application. When the VHN application sends an XML RPC to the HAVi application, at **S904**, it will be picked up by the HAVi VHN BCM (HAVi-VHN DCM). In turn, the VHN XML message will be translated into a HAVi message using the SEID of the HAVi application, at **S906**. Furthermore, the VHN BCM (via the HAVi-VHN DCM) sends the HAVi message to the HAVi application, at **S908**.

[0072] When the HAVi application **106** responds back to the VHN application, it does so using the VHN SEID address that was encoded into the HAVi message. The VHN BCM translates (via the HAVi-VHN DCM) the HAVi message into a XML RPC response using the assigned IP address of the VHN application.

[0073] Likewise, referring to **FIG. 10**, a VHN device **616** can control a HAVi device. Similar to the example above, the VHN device **616** queries the HNB & IR **604** for HAVi devices, at **S1000**. What is returned from the HNB & IR is the IP address (and possibly the SIED) of the HAVi device. The VHN device is free to send XML messages (using the assigned IP address of the HAVi device) to the VHN BCM (via the HAVi-VHN DCM), at **S1002**. The VHN BCM recognizes the IP address of the VHN device **616** and reformats the XML message into a HAVi message that will be sent to the HAVi DCM (via the HAViVHN DCM), at **S1004**.

[0074] The response from the device's HAVi DCM will send a HAVi message to the VHN BCM (HAVi-VHN DCM) using its mapped SEID address, at **S1006**. This will cause the VHN BCM to translate the HAVi message into a XML message that will be sent to the VHN device, at **S1008**. The SEID and IP address of the devices will be used to cross-reference each device (VHN and HAVi).

[0075] Similarly, a VHN device **616** can control a HAVi application **106**. The only difference between this case and the one above is that the VHN device uses the HAVi application IP address which is obtained from the HNB & IR. The VHN BCM will translate the IP address of the HAVi application into the respective SEID. Everything else is the same, and is shown in **FIG. 10**.

[0076] Still referring to **FIG. 6**, in other embodiments according to the present invention, the HAVi application **106** can control a device (e.g., the DTV **616**) on the VHN network **502**. Referring to **FIG. 11**, as shown in steps **S1100** and **S1102**, when the VBCM **600** discovers that there is a DTV on the VHN network, it creates the VHN DCM **622** (HAVi-VHN DCM). The VHN DCM can be considered to be a virtual DCM because the DTV physically resides on the VHN network and not the HAVi network.

[0077] Next, at step **S1104**, the VHN DCM **622** registers itself with the registry **114**. At step **S1106**, the HAVi application **106**, which is attempting to control a DTV, goes to the registry **114** and queries for all DTV's on the network. Subsequently, the HAVi application finds the DTV **616** SEID which enables it to control the DTV's respective DCM. The HAVi application does not have information that the DTV **616** is a VHN device.

[0078] At step **S1108**, the HAVi application **106** can now control the DTV **616** (e.g., turn it on or off, set the time, etc.) by sending commands to the VHN DCM **622** via HAVi messaging. The HAVi application thinks that it is talking to a HAVi DCM **124**, using the HAVi protocols. Furthermore, any of the HAVi software modules that communicate with the VHN DCM **622** do so through HAVi messaging.

[0079] At step **S1110**, the VHN DCM **622** can now communicate with the VBCM **600** via XML and HTML. At step, **S1112**, the VBCM, in turn, communicates with the HBCM **602** in XML. The HBCM **602** thus controls the DTV **616**, as shown in step **S1114**. The result is a HAVi application **106** running on a HAVi network **504** controlling a VHN device **616**. In some situation, it the VHN DCM (HAVi-VHN DCM) can interface directly with the client application. This is done if the VHN DCM contains the IP protocols and web protocols. In this case, the VHN DCM using the IP over IEEE 1394 protocols to communicate with the VHN device.

[0080] In an alternate embodiment, referring to **FIG. 12**, a HAVi application **106** can control a VHN application. A HAVi application queries the HAVi registry for VHN applications (an SEID of the VHN application is returned), at **S1200**. Once the HAVi application obtains the SEID of the VHN application, it is free to send HAVi messages to the VHN application. The HAVi-VHN DCM translates the HAVi message to XML messages, at **S1202** and **S1204**. The SEID of the VHN application is used to retrieve the VHN applications IP address. The XML message is transmitted using IP/1394.

[0081] The VHN application uses the IP address of the HAVi application when it sends a response. The VHN BCM (via the HAVi-VHN DCM) translates the XML message into a HAVi message and sends it to the HAVi application, at **S1206**.

[0082] Moreover, a HAVi device can control a VHN device **616**, as illustrated in **FIG. 13**. A HAVi device is able to control a VHN device by going to the HAVi registry **114** and getting the SEID of the VHN device. The HAVi device sends a message to the VHN device (via HAVi messaging), at **S1300**. The VHN device's HAVi-VHN DCM is able to receive the HAVi message and translate it into a XML message, at **S1302**. It maps the SEID address into the VHN devices IP address. When the VHN device **616** responds to the HAVi device it does so by sending an XML response, at **S1304**. The VHN BCM (via the HAVi-VHN DCM) translates the XML message into a HAVi message and sends it to the HAVi DCM, at **S1306** and **S1308**.

[0083] In another embodiment, as shown in **FIG. 14**, a HAVi device can control a VHN application. A HAVi device

can control a VHN device by getting its SEID from the HAVi registry **114** and sending it messages, at **S1400**. The HAVi device's DCM sends HAVi messages to the HAVi-VHN DCM which in turn sends XML messages to the VBCM, at **S1402**. The VBCM in turns sends XML messages to the VHN application, at **S1404**. When it comes time for the VHN application to respond to the HAVi device, it will send XML messages (using the IP address of the HAVi device) back to the VBCM. At this point, the message will be parsed and passed back to the HAVi-VHN DCM. The HAVi-DCM will reformat the VHN message into HAVi messages and pass them on to the HAVi DCM. At this point the HAVi DCM can send proprietary commands (i.e., AV/C commands) to the HAVi device.

[0084] The above description is illustrative and not restrictive. Many variations of the invention will become apparent to those of skill in the art upon review of this disclosure. The scope of the invention should, therefore, be determined not with reference to the above description, but instead should be determined with reference to the appended claims along with their full scope of equivalents.

What is claimed is:

1. A method of facilitating interoperability between two networks, the method comprising:

providing a VHN network having a VHN element;

providing a HAVi network having a HAVi element; and

translating messages via a protocol translator coupled with the VHN network and the HAVi network;

wherein the interoperability is facilitated between the HAVi element and the VHN element.

2. The method of claim 1, wherein the protocol translator comprises:

a HAVi bridge control manager;

a VHN bridge control manager coupled with the HAVi bridge control manager; and

a HAVi-VHN DCM coupled with the VHN bridge control manager.

3. A method of facilitating interoperability between two networks, the method comprising:

providing a VHN network having a VHN element;

providing a HAVi network having a HAVi element;

providing a protocol translator coupled with the VHN network and the HAVi network; and

controlling the HAVi element with the VHN element.

4. The method of claim 3, wherein the protocol translator comprises:

a HAVi bridge control manager;

a VHN bridge control manager coupled with the HAVi bridge control manager; and

a HAVi-VHN DCM coupled with the VHN bridge control manager.

5. A method of facilitating interoperability between two networks, the method comprising:

providing a VHN network having a VHN element;

providing a HAVi network having a HAVi element;

providing a protocol translator coupled with the VHN network and the HAVi network; and

controlling the VHN element with the HAVi element.

6. The method of claim 5, wherein the protocol translator comprises:

a HAVi bridge control manager;

a VHN bridge control manager coupled with the HAVi bridge control manager; and

a HAVi-VHN DCM coupled with the VHN bridge control manager.

7. The method of claim 5, wherein controlling comprises controlling a HAVi device with a VHN device.

8. The method of claim 5, wherein controlling comprises controlling a HAVi device with a VHN application.

9. The method of claim 5, wherein controlling comprises controlling a HAVi application with a VHN device.

10. The method of claim 5, wherein controlling comprises controlling a HAVi application with a VHN application.

11. A computer-readable media for facilitating interoperability between a VHN network having a VHN element and a HAVi network having a HAVi element, the computer-readable media comprising:

providing instructions for coupling the VHN network with the HAVi network; and

providing instructions for facilitating interoperability between the HAVi element and the VHN element.

12. The computer-read able media of claim 1, wherein providing instructions for facilitating interoperability comprises:

providing instructions for a HAVi bridge control manager;

providing instructions for a VHN bridge control manager coupled with the HAVi bridge control manager; and

providing instructions for a HAVi-VHN DCM coupled with the VHN bridge control manager.

13. A system for facilitating interoperability between two networks, the system comprising:

a VHN network having a VHN element;

a HAVi network having a HAVi element; and

a protocol translator coupled with the VHN network and the HAVi network;

wherein the protocol translator facilitates interoperability between the HAVi element and the VHN element.

14. The system of claim 13, wherein the protocol translator comprises:

a HAVi bridge control manager;

a VHN bridge control manager coupled with the HAVi bridge control manager; and

a HAVi-VHN DCM coupled with the VHN bridge control manager.

* * * * *

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(54) SYSTEM AND METHOD FOR ENHANCED HAVI BASED DEVICE IMPLEMENTATION

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(52) U.S. Cl. 717/174

(57) ABSTRACT

The invention is a system method for providing extended functionality for a HAVi compatible device. The HAVi compatible device is connectable to a HAVi network. The extended functionality is defined by control data stored on a remote server external to the HAVi network. The remote server is connected to an external network. The external network comprises a network external to the HAVi network. The HAVi network comprises several other HAVi compatible devices. The system comprises an external network connection device for providing data communications between the HAVi network and the remote server. The external network connection device is connectable to the external network. The external network connection device is for receiving the control data from the remote server. The system further includes a control module, comprising a device control module (DCM) containing a special functional control module (FCM). The control module is for providing the extended functionality for the HAVi compatible device based on the control data.

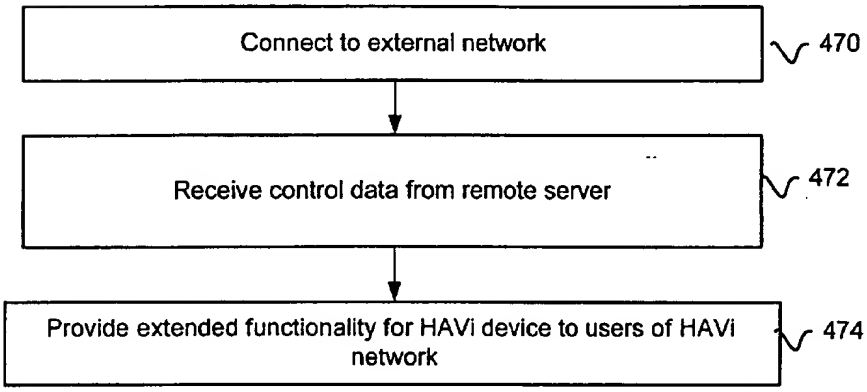


Fig. 1
(Prior Art)

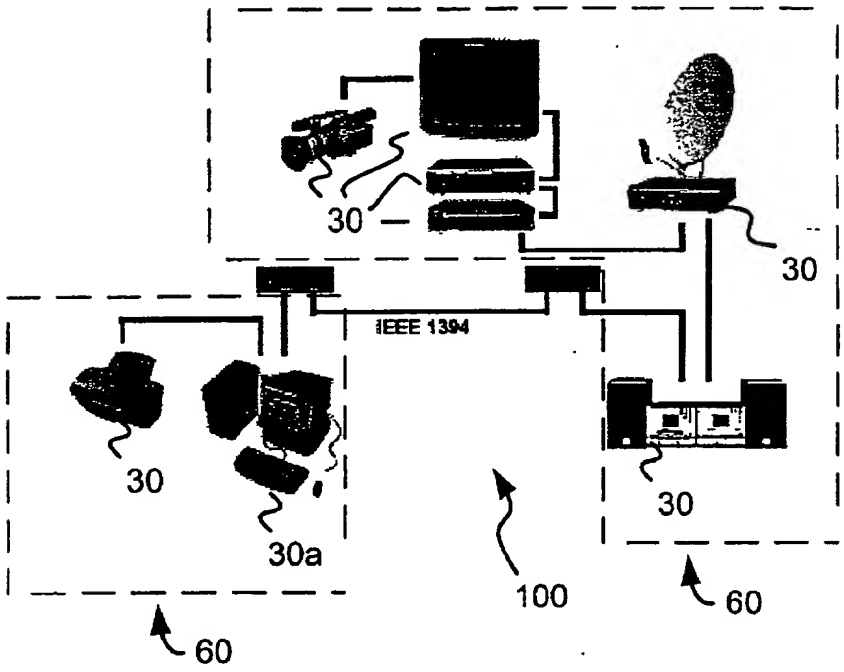


Fig. 2
(Prior Art)

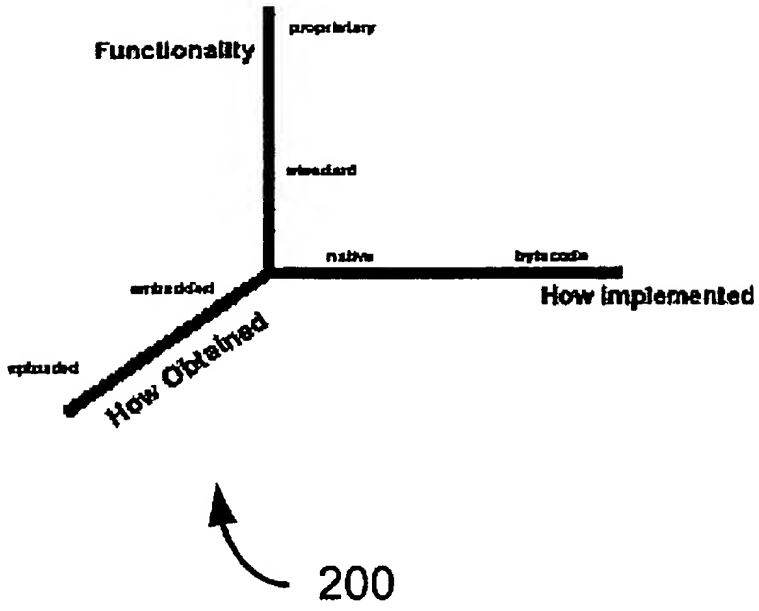


Fig. 3

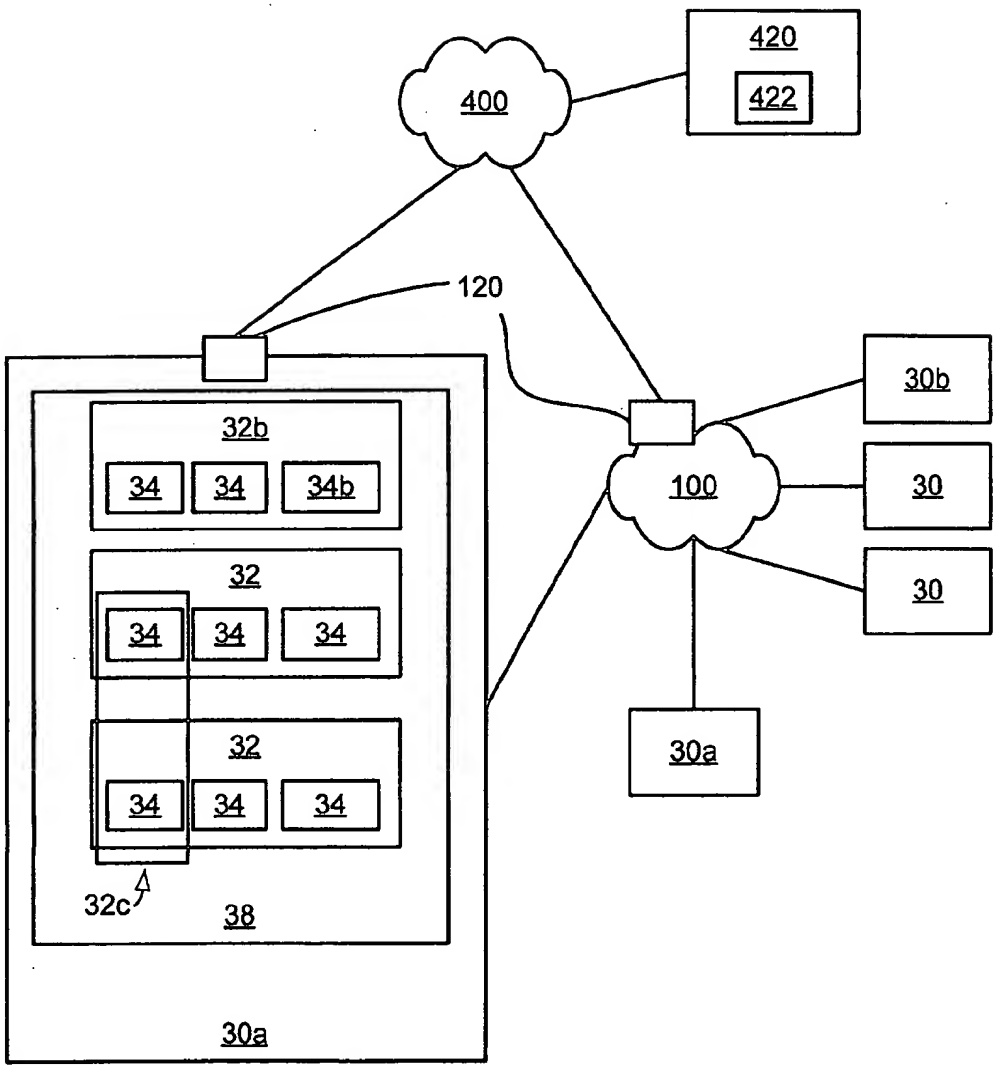

420
422
400
120
30b
32b
34
34
34b
100
30
32
34
34
34
30
32
34
34
34
30a
32c
38
30a

Fig. 4

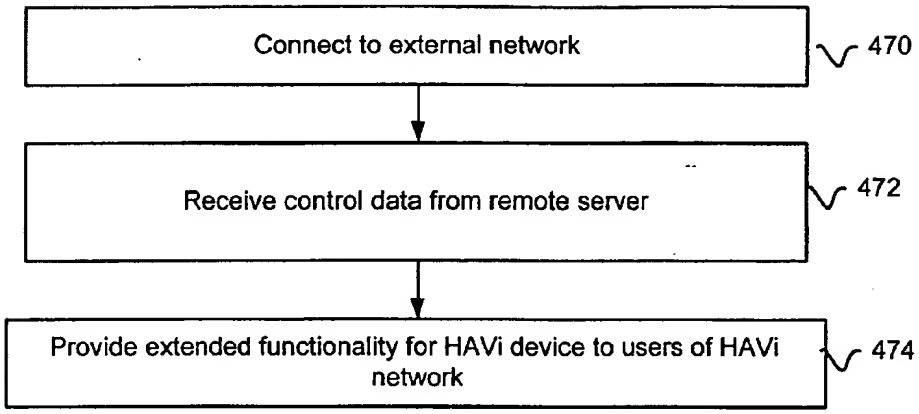
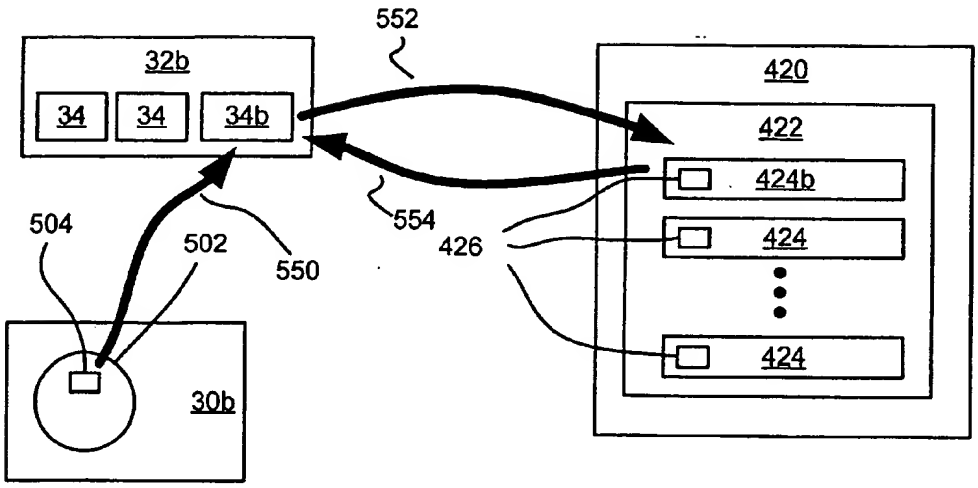

Connect to external network
470
Receive control data from remote server
472
Provide extended functionality for HAVi device to users of HAVi network
474

Fig. 5



SYSTEM AND METHOD FOR ENHANCED HAVI BASED DEVICE IMPLEMENTATION

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The invention is a system and method for enhanced HAVi based device implementation. Specifically, the invention is a system method for providing extended functionality for a HAVi compatible device.

[0003] 2. Description of the Prior Art and Related Information

[0004] Recently, a communications standard that allows all manner of digital consumer electronics, or home devices, to communicate with each other has been established by some of the world's leading manufacturers in the field. The standard, called the Home Audio Video Interoperability, or HAVi, standard allows users to enjoy the convenience of easy interoperability of these devices. The types of devices supported by HAVi include: tuner, VCR, clock, camera, AV disc, display, amplifier, modem, and Web proxy.

[0005] A specification has been developed for the HAVi standard. The HAVi specification was developed mainly for home entertainment audio visual (AV) networks, providing high bandwidth for transmitting multiple AV streams and featuring easy plug-and-play functionality, using an underlying IEEE-1394 digital interface. The HAVi specification defines a set of APIs and middleware capable of automatically detecting devices on the network, coordinating the functions of various devices, installing applications and user interface software on each device, and ensuring interoperability among multiple brands of devices. Some of the companies involved in developing the specification are:

[0006] Grundig AG,

[0007] Hitachi Ltd.,

[0008] Matsushita Electric Industrial Co.,

[0009] Royal Philips Electronics,

[0010] Sharp Corporation,

[0011] Sony Corporation,

[0012] Thomson Multimedia, and

[0013] Toshiba Corporation.

[0014] The HAVi specification is currently in its first version, last updated Jan. 18, 2000, and can be found in .pdf format at www.HAVi.com.

[0015] HAVi technology allows all devices on a HAVi network to be operated from anywhere on the HAVi network, which is local in nature, using whichever device is nearest to the user. HAVi is a digital audio-visual (AV) networking initiative that provides a networking software specification for seamless interoperability among devices. Equally important, the HAVi specification is AV-device-centric, so it has been designed to meet the particular demands of digital audio and video. It defines an operating-system-neutral middleware that manages multi-directional AV streams, event schedules, and registries, while providing application program interfaces (APIs) for the creation of a new generation of software applications. Whatever the brand of device, the focus is on the control and content of digital AV streams. HAVi software takes advantage of the powerful resources of chips built into modem audio and video devices to give users the management function of a dedicated audio-video networking system.

[0016] The IEEE 1394 standard (by I.LINK or FIREWIRE) has been chosen as the interconnection medium. IEEE 1394 has more than enough capacity to simultaneously carry multiple digital audio and video streams around a local area, for example a house, and provides support for digital copy protection. Leading suppliers of consumer electronics are already committed to producing HAVi compatible devices.

[0017] The HAVi standard gives users instantly coordinated functionality among usable devices without that user becoming a system administrator. Each device added to the network automatically installs its own application and interface software. The complexity and sophistication has been built into HAVi compatible devices, with the power of the HAVi standard being harnessed to work behind in the background so that control is simple for the user. As each device is added to a local HAVi network, it's automatically registered by the system so that other devices know what it is capable of.

[0018] Devices may possess several functions across brands, which is not a problem with the HAVi network because HAVi has standardized the application programming interfaces of the most common AV functions. This means that a VCR can search for a device that offers a clock with the time-of-day and automatically set its own timers.

[0019] HAVi's upgradeable nature means that users are able to increase the functionality of devices as updates become available. Not even a home PC is required for a HAVi network to operate.

[0020] Functions on a device or device within the HAVi networking system may be controlled from another device within the system. For example, a search may be performed for an available VCR to record a TV program, with commands being given via a menu selection from another TV display.

[0021] Entertainment products from different manufacturers may communicate with each other when connected into a HAVi network. A variety of VCR's, hi-fis, DVD players, minidisc machines, active loudspeakers, set-top boxes may all be daisy-chained together to be presented on a TV for a user to control from one remote control device.

[0022] HAVi compliant devices automatically announce their presence and capabilities to every other device on the HAVi network, greatly simplifying installation and setup. The user of the HAVi network simply may add a device on a plug-and-play basis. Complicated and difficult installation instructions are not required. Nor is any configuration of network addresses or device drivers required.

[0023] Today's i.LINK enabled camcorders and other devices are able to be controlled on a HAVi network for basic functions. Most HAVi compliant devices come with their own dynamic device control modules (DCMs). Updating functionality can be done by downloading/uploading new capabilities via the Internet. Also, additional or replacement products can simply be incorporated into the network.

[0024] As consumers incrementally build entertainment networks from a basic cluster to a home network, exciting new applications will emerge to offer additional flexibility, control and personalization to home entertainment. The HAVi standard makes it easier for companies to build and market new application programs by using HAVi's API's or programming in Java. Bridges will also be available to home control systems, security systems, communication systems and PC based applications.

[0025] The HAVi architecture is intended for implementation on consumer electronics (CE) devices and computing devices; it provides a set of services which facilitate interoperability and the development of distributed applications on home networks. HAVi is intended for, but not restricted to, CE devices supporting the IEEE Std 1394-1995 [3] (and future extensions) and IEC 61883 [4] interface standards. Since a goal of the HAVi architecture is to be future-proof, interoperability is more than a common command set. HAVi is a software architecture that allows new devices to be integrated into the home network and to offer their services in an open and seamless manner. The HAVi Architecture provides: a set of software elements along with the protocols and APIs needed to achieve interoperability; device abstraction and device control models; an addressing scheme and lookup service for devices and their resources; an open execution environment supporting visual presentation and control of devices, and providing runtime support for third party applications; communication mechanisms for extending the environment dynamically through plug-and-play capabilities; a versioning mechanism that preserves interoperability as the architecture evolves; and management of isochronous data streams. The specification describes the constructs HAVi implements to support interoperability.

[0026] One of the basic operating elements used multiple times in HAVi networks comprises a functional control module (FCM). A FCM is a HAVi software element that provides an interface for controlling a specific functional component of a device. Another basic element comprises a device control module (DCM). A DCM is a HAVi software element that provides an interface for controlling general functions of a device. A DCM provides the interface to the HAVi network, exposing a set of functionality to the network. FCMs are functional building blocks that may be combined to create the total functionality of a physical or virtual multimedia device. Two DCMs could use the same set of FCMs to create two different virtual devices.

[0027] With reference to **FIG. 1**, the underlying structure for a HAVi network **100** comprises interconnected clusters **60** of HAVi devices **30**. Typically, there will be several clusters **60** in a network **100**, with one per floor or one per room. Each cluster **60** will work as a set of interconnected devices **30** to provide services to users. Often one device **30***a* will control other devices **30**. However, the HAVi architecture is sufficiently flexible to allow networks **100** with no single master control device.

[0028] The HAVi architecture supports legacy devices **30**, i.e., devices **30** that are at least not fully compatible with the HAVi specification. This is important since the transition to networked devices **30** is gradual—with manufacturers not suddenly producing only networked devices **30** and consumers not suddenly replacing their existing devices **30**. Legacy devices **30** can also be characterized by the degree to which they support 1394 and industry standard protocols for 1394 such as IEC 61883.

[0029] Each device **30** has, as a minimum, enough functionality to allow it to communicate with other devices **30** in the system **100**, with the exception of legacy devices **30** which are handled as explained below. During the course of interaction, devices **30** may exchange control information and data in a peer-to-peer fashion. This ensures that, at the communication level, no one device **30** is required to act as a master or controller for the system **100**. However, it also allows a logical master or controller **30***a* to impose a control structure on the basic peer-to-peer communication model. The HAVi control model makes a distinction between controllers **30***a* and controlled devices **30**. A controller **30***a* is a device that acts as a host for a controlled device **30**. A controlled device **30** and its controller **30***a* may reside on the same physical device **30** or on separate physical devices **30***a*. In terms of the HAVi control model, a controller **30***a* hosts a device control module (DCM) for the controlled device **30**. The control interface for a device **30** is exposed via an API of the DCM. This API is the only access point for applications to control the device **30**. For instance, an intelligent television in the family room might be the controller **30***a* for a number of interconnected devices **30**. A controlled device **30***a* could contain Java bytecode that constructs a user interface for the device **30** and allows external control of the device **30**. When the devices **30** are first connected, the controller **30***a* obtains the user interface and control code for the device **30** comprising the DCM for the device. An icon representing the device **30** may then appear on the television screen, and manipulating the icon may cause elements of the DCM to actuate the represented device or devices in prescribed ways. The network **100** allows a single device **30**, or a group of devices **30** communicating amongst themselves, to deliver a service to a user. When it is necessary for a device **30** to interact with a user, a GUI for the device may be presented on a device **30** with display capabilities (possibly the device in question or possibly a different device).

[0030] With reference to **FIG. 2**., DCMs are a central concept to the HAVi architecture and the source of flexibility in accommodating new devices **30** and features. A chart **200** in **FIG. 2** illustrates how DCMs can be distinguished in several ways. The first DCM characteristic is how the DCM is obtained by the controller. For example, the DCM may be embedded. An embedded DCM is a DCM that is part of the resident software on a controller **30***a*. A DCM may also be uploaded. An embedded DCM is one that is obtained from some source external to the controller **30***a* and is dynamically added to the software on the controller **30***a*.

[0031] The second characteristic is whether a DCM is controller **30***a* dependent or controller **30***a* independent. For example, a DCM may be native. A native DCM is one that is implemented for a specific platform. It may include machine code for a specific processor or access platform specific APIs for a device. A DCM may comprise a bytecode DCM. A bytecode DCM is one that is implemented in Java bytecode.

[0032] Finally, DCMs can be distinguished by their functionality, or, conversely, their range of use. For example, a DCM may comprise a standard DCM. A standard DCM is one that provides standard HAVi APIs. Such a standard

DCM provides basic functionality but is able to control a wide range of devices. A DCM may comprise a proprietary DCM. A proprietary DCM is a DCM that provides vendor-specific APIs in addition to the standard HAVi APIs. Such a proprietary DCM would offer additional features and capabilities over a standard DCM but could control a narrower range of devices, perhaps only a specific device **30** or model of a device **30**.

[0033] A DCM, is a software abstraction of a device **30** providing device **30** specific functionality to the HAVi network **100**. HAVi applications will not communicate with a device **30** directly but through the DCM of the device **30** or one of its FCMs. A DCM is a HAVi object in the sense that it is registered in a general registry with other HAVi objects, and can communicate with other HAVi objects via a general HAVi Messaging System. DCMs and FCMs are registered with their type and a HAVi unique identifier (HUID). The HUID allows applications to find the DCM or FCM after partial system unavailability, as when the device **30** represented by the DCM is momentarily removed from the network **100**. A DCM provides a set of basic methods for device **30** control and observation. The DCM can be used by HAVi devices **30** as well as any application.

[0034] A distinction is made between devices **30** which are each described to the network **100** by their DCM, and functional components of a device **30** which are described to the network **100** by FCMs within the DCM for the device **30**. A good example of this distinction can be found in a normal TV set. Although the TV set is generally one physical box, it contains several distinct controllable entities, e.g. the tuner, display, audio amplifier, etc. The controllable entities within a device are called functional components. The TV is the device **30** defined to the network with its DCM, and the functional components are defined by FCMs within the DCM.

SUMMARY OF THE INVENTION

[0035] The invention is a system and method for providing extended functionality for a HAVi compatible device. The HAVi compatible device is connectable to a HAVi network. The extended functionality is defined by control data stored on a remote server external to the HAVi network. The remote server is connected to an external network. The external network comprises a network external to the HAVi network. The HAVi network comprises several other HAVi compatible devices.

[0036] The system comprises an external network connection device for providing data communications between the HAVi network and the remote server. The external network connection device is connectable to the external network. The external network connection device is for receiving the control data from the remote server.

[0037] The system further includes a control module, comprising a device control module (DCM) containing a special functional control module (FCM). The control module is for providing the extended functionality for the HAVi compatible device based on the control data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] **FIG. 1** is a block diagram illustrating the underlying structure for a HAVi network according to the prior art;

[0039] **FIG. 2** is a chart illustrating how prior art DCMs can be categorized;

[0040] **FIG. 3** is a block diagram illustrating a system for providing extended functionality for a HAVi compatible device according to the present invention;

[0041] **FIG. 4** is a flow diagram illustrating the steps performed in a method performed by the system of **FIG. 3**; and

[0042] **FIG. 5** a block and data flow diagram illustrating the components and a process for retrieving control data from a remote server of the system of **FIG. 3**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0043] With reference to **FIG. 3**, a system for providing extended functionality for a HAVi compatible device **30*b*** is shown. The HAVi compatible device **30*b*** is connectable to a HAVi network **100**. The extended functionality is defined by control data **422** stored on a remote server **420** external to the HAVi network **100**. The remote server **420** is connected to an external network **350**. The external network **350** comprises a network external to the HAVi network **100**. The HAVi network **350** comprises several other HAVi compatible devices **30**.

[0044] The system comprises an external network connection device **120** for providing data communications between the HAVi network **100** and the remote server **420**. The external network connection device **120** is connectable to the external network **350**. The external network connection device **120** is for receiving the control data **422** from the remote server **420**.

[0045] The system further includes a control module, shown as device control module (DCM) **32*b*** containing a special functional control module (FCM) **34*b*** in **FIG. 3**. The control module **32*b*-34*b*** is for providing the extended functionality for the HAVi compatible device **30*b*** based on the control data **422**. In **FIG. 3**, the DCM **32*b*** is shown containing several FCMs **34** and the special functional control module **34*b***. The DCM **32*b*** is for presenting the functionality of the HAVi compatible device **30*b*** to the HAVi network **100**.

[0046] The device control module **32*b*** may be included on a master control device **30*a*** comprising a processor connected to the HAVi network **100**. The processor **30** has a memory module **38** for storing the DCM **32*b*** and functional control module **34*b***. DCMs **32** for the other HAVi compatible devices **30** are present on the master control device **30**, with each of the DCMs containing FCMs **34** for those devices.

[0047] The processor **30*a*** may further comprise the external network connection device **120** as opposed to the external network connection device **120** being directly connected to the network **120**. The external network connection device **120** may comprise a modem, cable modem, ISDN device, or DSL connector.

[0048] The processor **30*a*** is for presenting the device control module **32*b*** to a user of the HAVi network **100** for providing the user with the capability of controlling the HAVi compatible device **32a** with the extended functionality. The device control module **32*b*** is presented with the its

functional control modules **34-34***b* in the display presented by the DCM **34***b* described in the HAVi specification. There is a FCM **34***b* for the legacy device **30***b* and an FCM **34***b* for a virtual device representing the functionality of a set of control data **422** stored on a remote server **420**. A single DCM **32***b* exposes the combined functionality of the legacy device **30***b* and the control data **422** so that it has the same DCM **32***b* interface as a more intelligent, or contemporary, non-legacy device, and therefore causes the legacy device **30***b* to appear to the user as if it were a non-legacy device **30***b*.

[0049] The HAVi compatible device **30***b* may comprise a legacy device wherein the extended functionality is for causing the HAVi compatible device **30***b* to function as a contemporary device with respect to a user of the HAVi network **100**. For example, the HAVi compatible device **30***b* may comprise a compact disk player not having built in ability for presenting artist and song information for a compact disk inserted into the compact disk player. The control data **422** may thus be for presenting artist and song information for the compact disk to the user. The control data **422** would thus comprise artist and song information matched to one or more identification codes read from the compact disk such that the artist and song information may be presented to the user for selection.

[0050] Another embodiment of the system comprises a first usable device **30***b* comprising one of a plurality usable devices **30** capable of being connected to a local network **100**. Each usable device **30**, **30***a*, **30***b* is capable of receiving commands from a user of the local network **100**.

[0051] The external network connection device **120** is for providing data communications between the local network **100** and a remote server **420** connected to the external network **350**. The external network connection device **120** is thus connectable to the external network **350**. The network connection device **120** is for receiving control data **422** from the remote server **420**. The control data **422** defines extended functionality for a first **30***b* of the one or more of the plurality of usable devices **30-30***b*. One or more control modules **32***b*-**34***b* is for providing the extended functionality for the one or more usable devices **30***b* based on the control data **422**.

[0052] One usable device **30***a* of the plurality of usable devices comprises a processor having a device control module **32***b*. The device control module **32***b* comprises a first functional control module **34***b* for presenting the extended functionality through presentation of the device control module **32***b* to a user of the processor **30***a* for controlling the first usable device **30***b*, thereby allowing the user to use the extended functionality.

[0053] The extended functionality comprises a plurality of extended functions for controlling the first usable device **30***b*. The device control module **32***b* comprises a plurality of functional control modules **34-34***b*. Each functional control module **34-34***b* comprises a subset of the plurality of extended functions.

[0054] The plurality of usable devices **30**, **30***a*, **30***b* may comprise two or more processors **30***a*. The device control module **32***b* may present a selected one of the functional control modules **34-34***b* to each of the two or more processors **30***a*, thereby allowing a user of each of the two or more processors **30***a* to control the first device **30***b* based on the respective subset of extended functions of the respective functional control module **34-34***b* presented to the respective processor **30***a*.

[0055] One or more device control modules **32***c* may be constructed from various functional control modules **34** from other device control modules **32**. This is useful for usable devices **30** that may have functionality defined by functional control modules from two or more different device control modules **32** that may present the device control module **32***c* to the HAVi network **100** with those functional control modules **34**.

[0056] With reference to **FIG. 4** a flow diagram illustrating the steps performed in a method for providing extended functionality for a HAVi compatible device **30***b* is shown. The first step comprises providing data communications between the HAVi network **100** and the remote server **420**, step **470**. The next step is that the control data **422** is received from the remote server **420**, step **472**. The extended functionality for the HAVi compatible device **30***b* is then provided to a user of the HAVi network **100** based on the control data **422**, step **474**. The step of providing the extended functionality to the user comprises providing the user with the capability of controlling the HAVi compatible device **30***b* with the extended functionality by presenting the device control module **32***b* to the user of the HAVi network **100**.

[0057] With reference to **FIG. 5**, a diagram illustrating the components and a process for retrieving the control data **422** from the server **420** is shown. The server **420** contains the control data **422**. The control data **422** may be formatted into a database containing control data records **424**. Each control data record **424** includes, for example, control data for a compact disk title. Each control data record **424** may include an identification code **426** provided by a publisher of the publisher of a respective compact disk.

[0058] The HAVi device **30***b* may be loaded with a compact disk **502** having an identification code **504**. When the compact disk **502** is loaded into the HAVi device **30***b*, the identification code **504** is provided to the DCM **32***b* for the HAVi device **30***b*, step **550**. The identification code **504** read from the compact disk **502** is forwarded to the remote server **420**, step **552**. The identification code for the compact disk **504** is matched with an identification code **426** in a control data record **424***b*. Title and artist information from the control data record **424** is transmitted back to the FCM **34***b* of the DCM **32** that provides the extended functionality for the HAVi device **30***b*, step **554**. The artist and title information may now be presented for selection by a user on one of the HAVi devices **30**, **30***a* or **30***b* in the HAVi network **300**.

[0059] The above example illustrates operation of the system wherein the HAVi device **30***b* is a compact disk player. However, those skilled in the art would recognize other combinations of HAVi devices **30** and types of control data **422**. For example, the HAVi device **30***b* may comprise a television set that does not have digital menu presentation firmware built in. In this case, the control data record **424** that is matched may include digital channel grid information for presenting local television program information. The DCM **32***b* for the television **30***b* may convey a zip code or a geographic location code for identifying the local television viewing area for the user. The geographic location code

may comprise the identification code **504** that is matched with the control data record identification code **426** in the control data record **424**. Local television program information may thus be downloaded from the server **420** to the FCM **34***b* for presentation on the viewing screen of the television **30***b* through the DCM **32***b*.

[0060] While the particular method and apparatus shown and described herein in detail is fully capable of attaining the objects of this invention, it is understood that the description and drawings represent the presently preferred embodiment of the invention and are, as such, a representation of the subject matter which is broadly contemplated by the present invention. It is further understood that the scope of the present invention fully encompasses other embodiments that may become obvious to those skilled in the art, and that the scope of the present invention is accordingly limited by nothing other than the appended claims.

What is claim is:

1. A system for providing extended functionality for a HAVi compatible device, the HAVi compatible device being connectable to a HAVi network, the extended functionality defined by control data stored on a remote server external to the HAVi network, the remote server being connected to an external network, the external network comprising a network external to the HAVi network, comprising:

an external network connection device for providing data communications between the HAVi network and the remote server;

the external network connection device connectable to the external network;

the external network connection device for receiving the control data; and

a control module for providing the extended functionality for the HAVi compatible device based on the control data.

2. The system of claim 1 wherein the control module comprises a functional control module.

3. The system of claim 2 wherein the control module further comprises a device control module.

4. The system of claim 3 wherein the device control module comprises a processor connected to the HAVi network, the processor having a memory module for storing the device control module; the processor further comprising the external network connection device.

5. The system of claim 4 wherein the processor is for presenting the device control module to a user of the HAVi network for providing the user with the capability of controlling the HAVi compatible device with the extended functionality.

6. The system of claim 1 wherein the HAVi compatible device comprises a legacy device wherein the extended functionality is for causing the HAVi compatible device to function as a contemporary device with respect to a user of the HAVi network.

7. The system of claim 6 wherein the HAVi compatible device comprises a compact disk player not having built in ability for presenting artist and song information for a compact disk inserted into the compact disk player, and wherein the control data is for presenting artist and song information for the compact disk to the user.

8. The system of claim 7 wherein the control data comprises artist and song information matched to one or more identification codes read from the compact disk such that the artist and song information may be presented to the user for selection.

9. A system comprising a first usable device comprising one of a plurality usable devices capable of being connected to a local network, each usable device being capable of receiving commands from a user of the local network:

an external network connection device for providing data communications between the local network and a remote server connected to an external network, the external network connection device connectable to the external network, the external network connection device for receiving control data from the remote server, the control data defining extended functionality for a first of the one or more of the plurality of usable devices; and

a control module for providing the extended functionality for the first usable device based on the control data.

10. The system of claim 9 wherein a second of the plurality of usable devices comprises a processor having a device control module.

11. The system of claim 10 wherein the device control module comprises a first functional control module, the device control module for presenting the extended functionality to a user of the processor for controlling the first usable device, thereby allowing the user to use the extended functionality.

12. The system of claim 10 wherein the extended functionality comprises a plurality of extended functions for controlling the first usable device; two or more device control modules each comprising a plurality of functional control modules, each functional control module comprising a subset of the plurality of extended functions, the plurality of usable devices comprising two or more processors, each of the device control modules for presenting selectively to one of the two or more processors, thereby allowing a user of each of the two or more processors to control the first device based on the respective subset of extended functions of the respective functional control modules of the device control module presented to the respective processor.

13. A method for providing extended functionality for a HAVi compatible device, the HAVi compatible device being connectable to a HAVi network, the extended functionality defined by control data stored on a remote server external to the HAVi network, the remote server being connected to an external network, the external network comprising a network external to the HAVi network, the method comprising the steps of:

providing data communications between the HAVi network and the remote server;

receiving the control data from the remote server; and

providing the extended functionality for the HAVi compatible device based on the control data.

14. The method of claim 13 comprising providing the user with the capability of controlling the HAVi compatible device with the extended functionality.

15. The method of claim 13 wherein the HAVi compatible device comprises a legacy device wherein the extended

functionality is for causing the HAVi compatible device to function as a contemporary device with respect to a user of the HAVi network.

16. The method of claim 15 wherein the HAVi compatible device comprises a compact disk player not having built in ability for presenting artist and song information for a compact disk inserted into the compact disk player, and wherein the control data is for presenting artist and song information for the compact disk to the user.

17. The method of claim 16 comprising reading one or more identification codes from the compact disk and matching the one or more identification codes with the control data to present the artist and song information such that the artist and song information may be presented to the user for selection based on the identification code.

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